The Impact of a Text-Reader Support Program on Intermediate Students' Reading Comprehension

Tieha McGee, B.A., B.Ed.

Department of Graduate and Undergraduate

Studies in Education

Submitted in partial fulfillment

of the requirements for the degree of

Master of Education

Faculty of Education, Brock University

St. Catharines, Ontario

Abstract

This study examined the efficacy of providing four Grade 7 and 8 students with reading difficulties with explicit instruction in the use of reading comprehension strategies while using text-reader software. Specifically, the study explored participants' combined use of a text-reader and question-answering comprehension strategy during a 6-week instructional program. Using a qualitative case study methodology approach, participants' experiences using text-reader software, with the presence of explicit instruction in evidence-based reading comprehension strategies, were examined. The study involved three phases: (a) the first phase consisted of individual interviews with the participants and their parents; (b) the second phase consisted of a nine session course; and (c) the third phase consisted of individual exit interviews and a focus group discussion. After the data collection phases were completed, data were analyzed and coded for emerging themes, with quantitative measures of participants' reading performance used as descriptive data. The data suggested that assistive technology can serve as an instructional "hook", motivating students to engage actively in the reading processes, especially when accompanied by explicit strategy instruction. Participants' experiences also reflected development of strategy use and use of text-reader software and the importance of social interactions in developing reading comprehension skills. The findings of this study support the view that the integration of instruction using evidence-based practices are important and vital components in the inclusion of text-reader software as part of students' educational programming. Also, the findings from this study can be extended to develop in-class programming for students using text-reader software.

Acknowledgements

I would like to take this opportunity to thank those who assisted me in successfully completing my thesis research. First and foremost, I would like to acknowledge the teachers who instilled in me a love of learning that continues to grow as I continue to learn. With this in mind, I would like to say thank you to an educator who played an integral role in the development and completion of this thesis and in my development as an educator, Dr. Vera Woloshyn. Thank you for your never-ending and generous support, expansive knowledge and expertise, and your mentorship throughout my time as an M.Ed. student. Also, thank you to my committee members, Dr. Tiffany Gallagher and Dr. Tony DiPetta, for your time and your expertise. Your feedback and support assisted in my growth as a researcher and increased the quality of my work.

I would like to say thank you to my family who have offered unconditional love, encouragement, and support while I pursued my academic career, without which I would not have made it through this endeavour. Thank you to my big brother, Jeremie, who not only offers unconditional support but is always willing to lend a hand whenever I need something! To my closest friends, thank you for your loving encouragement, advice, and support! Also, thank you for providing me with company on the countless "thesis breaks" which, as funny as it may seem, assisted me in completing this academic process.

I would also like to thank the students and their families who participated in this study, and my program assistant, Cheryl Osborne. Without everyone's commitment to this research, it would not have been possible. Each of you contributed to assisting me in reaching one of my goals, and for that I thank you from the bottom of my heart!

Finally, an acknowledgement to those who assist graduate students in achieving

goals by providing funding for research, I would like to thank the Social Studies and Humanities Research Council and the Brock University Faculty of Education for providing grants that allowed this research to take place.

Dedication

This thesis is dedicated to two very important and wonderful people who have inspired me to strive for the best and have supported me while I set out to reach new goals; my parents.

My mother, who has been my biggest 'cheerleader', always encouraging me to move forward, attempt new things, and offering the support I need to achieve my goals. It is with your encouragement in my mind that I am able to adventurously step forward and attempt these new things and reach my goals, knowing that I have your support.

My father, who is my rock, always there supporting me and providing me with love, guidance, and advice, no matter the subject. Dad, you have always encouraged me to reach for higher heights and to do my best in everything that I set out to achieve. Your belief in me has always been a constant source of strength for me and for that unending support, I thank you.

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CHAPTER ONE: INTRODUCTION TO THE STUDY

Reading is an integral part of everyday life in our global society (Leu, Kinzer, Coiro, & Cammack, 2004). Written language surrounds us in our daily world, assuming diverse formats from textbooks to newspapers, emails, and instructional pamphlets. Despite the continual increase in literacy rates in Canada since the 1970s, many students continue to leave high school without functional literacy levels (Statistics Canada, 2007). Students who leave our educational system without acquiring the means to decode and/or comprehend text are lacking a vital part of their ability to communicate and understand the written language that surrounds them. Four out of 10 adult Canadians, approximately 9 million people, have reading difficulties (Statistics Canada, & Organization for Economic Cooperation and Development [OECD], 2005). It is not only adults who experience reading difficulties, over half (52%) of Ontario students identified with special learning needs have learning disabilities, with the majority (80%) of these involving reading difficulties (Lerner, 2003). There are also a large percentage of students who struggle with reading difficulties and remain formally unidentified by the educational system (Lerner, 2003; Winzer, 2007).

Reading difficulties are pervasive and low literacy skills are associated with a multitude of consequences for students who are afflicted by them. These students can feel marginalized by their poor reading abilities in the general classroom and this may result in behaviour problems and poor social relationships (Winzer, 2007). Reading difficulties can also lead to poor academic achievement in other subject areas (Winzer). Adolescents with reading difficulties also display negative behavioural tendencies that impede learning, such as lack of motivation and low self-confidence (Deshler, Ellis, & Lenz,

1996; Lerner, 1997). Students with reading difficulties also are more likely to drop out of high school than students with average reading abilities (Daniel, Walsh, Goldston, Arnold, Reboussin, & Wood, 2006; Dunn, Chambers, & Rabren, 2004). It is critical then that educators find ways to accommodate students and assist them to acquire reading skills rather than allowing them to leave the education system without the literacy skills that are required in today's world. The purpose of this study was to examine intermediate-grade struggling readers' experiences and perceptions of using an assistive text-reader technology while simultaneously receiving explicit instruction in the use of evidence-based comprehension strategies.

Background of the Problem

The majority of students with reading difficulties struggle with the basic foundational blocks of reading; phonological awareness and decoding (Snow, Burns, & Griffin, 1998). When these foundational blocks of reading are not present, students focus much of their cognitive processes on trying to decode the words within a text (LaBerge & Samuels, 1974; Ormrond, 1999). The difficulties are compounded by the need to draw meaning from these words in order to comprehend the text. As students progress through the "learning to read" curriculum of the primary grades, they are expected to begin to glean meaning from what they are decoding. As the "learning to read" curriculum transitions over to the "reading to learn" curriculum in the junior and intermediate grades, students are provided with comprehension instruction that assumes reading fluency (i.e., decoding and reading speed). Students in the junior and intermediate grades who continue to struggle with decoding have less cognitive resources available with which to apply comprehension strategies (Ormrond).

Overall, educational researchers agree that while decoding skills are a critical component of good reading, comprehension of text is the overriding goal of literacy instruction (Durkin, 1993; National Reading Panel, 2000). Comprehension of text is the intentional process of gaining meaning from text (Durkin; Sweet & Snow, 2003).

Junior and intermediate students who are provided with remedial decoding instruction also require instruction in comprehension strategy application and use. While good readers have been found to apply comprehension strategies automatically, research has shown that poor readers do not tend to apply these strategies while reading (Fisher, Schumaker, & Deschler, 2002; Pressley & Afflerbach, 1995). Students who fail to learn strategies or effectively apply strategies that facilitate comprehension of text are failing to read. Reading with no understanding of what is being communicated through the written text is simply mimicry. Haycock and Huang (2001) found that only one in seventeen 17-year-olds can read and make meaning from specialized text, such as the newspaper science section. Comprehending specialized text is central to success in most employment positions as well as in education, especially at the secondary and postsecondary levels. Students who are unable to derive meaning from such texts are at risk for obtaining lower paying positions than those with average reading abilities (Statistics Canada, 2007). Students with such reading difficulties are also less likely to attend postsecondary institutions, which increases their risk of obtaining lower paying employment positions (Statistics Canada).

There is substantial research related to the prevention and remediation of reading difficulties. However, most of this research is focused on students in the primary grades. One of the most successful factors in preventing and/or intervening reading difficulties is

the early identification of children who have or are at risk for reading difficulties (Lerner, 2003; Snow et al., 1998). Children who are provided with early intervention and relevant supports throughout subsequent grades can acquire the skills that are necessary for later successful reading (Snow et al.). Students who are not provided with early intervention are at risk for falling farther behind their same grade peers, with these difficulties intensifying throughout the later grades (Snow et al.; Stanovich, 1986). Such intensified difficulties are, in part, due to the progressive nature of reading abilities. Consider that students who develop the ability to decode and comprehend text tend to read more and thus, become better readers (Stanovich). Many students who struggle with reading, on the other hand, tend to avoid reading, perpetuating their reading difficulties in comparison to their peers (Stanovich). Furthermore, in addition to perpetuating reading difficulties, students who read less often can have voids in world knowledge in comparison to good readers. Reading difficulties are exacerbated when students do not possess relevant prior knowledge (NRP, 2000).

More positively, research into comprehension strategy instruction and recent technological advancements has provided more programming options for older students who require additional reading instruction and supports (NRP, 2000; Ontario Ministry of Education, 2005). While these students continue to benefit from remedial decoding instruction, recent technological innovations and their application in remedial education can provide them with access to the same or similar subject materials in order to complete the required educational expectations for their grade level (Ontario Ministry of Education). The assistive technology available to students to accommodate their learning needs provides educators with a variety of choices when planning for individual students.

Assistive technology (AT) is defined as, "...any item, piece of equipment, product or system, whether acquired commercially off the shelf, modified, or customized that can be used to directly assist, maintain, or improve functional capabilities of individuals with learning disabilities" (U.S. Department of Education, p. 20). Especially relevant to this study, advances in technology have provided students with tools that they can use to circumvent decoding difficulties and focus on deriving meaning from text (Marino, Marino, & Shaw, 2006). Text-readers are an example of such assistive technologies. Text-reader software provides students with a decoding accommodation that allows them to apply reading comprehension strategies to the text that is decoded and verbalized for them by the software (Marino et al.).

Statement of the Problem Context and Purpose of the Study

The purpose of this study was to examine intermediate students' experiences and perceptions of using a text-reader software (i.e., Kurzweil 3000; Kurzweil Educational Systems, 2002) while simultaneously receiving explicit instruction in the use of evidence-based comprehension strategies such as question-answering. Research has demonstrated that text-reader software can enhance the reading comprehension of college students with reading difficulties, with the most profound benefits resulting when reading instruction is provided concurrently with the use of text-readers (Blackhurst, 2004; Engstrom, 2005; Hasselbring & Bausch, 2005; Hecker, Elkind, Elkind, & Katz, 2002). However, relatively little research has been completed examining whether Grade 7 and 8 students' reading comprehension abilities can also benefit from the use of text-reader software. Conducting qualitative studies that examine elementary students' perceptions and experiences using text-readers can form the foundational research for further investigation. Qualitative

studies can also provide the foundation for quantitative research. For example, studies could be conducted to determine whether elementary students, specifically the intermediate grades, benefit from the use of such accommodations and the amount of instruction that students require to use text-readers in the classroom.

This study examined the experiences of Grade 7 and 8 students with reading difficulties in the use of text-reader software while exercising their reading comprehension skills with grade-level text. In this study, students' reading experiences were monitored while using text-reader software as they received explicit instruction in the use of evidence-based reading comprehension strategies.

The following questions form the foundation of the research study:

1. What are the reading experiences of Grades 7-8 students with reading difficulties while using the question answering strategy and text-reader software?
    - What are these students' experiences and perceptions about reading, reading comprehension, and assistive technologies? Do these perceptions change as a function of participating in the reading program and learning to use a reading comprehension strategy in conjunction with text-reader software?
2. What is the instructional experience of delivering a reading program based on explicit strategy instruction integrated with the use of text-reader software (i.e., What are the experiences of the instructor delivering this program of study)?

Rationale

Intermediate students who struggle with decoding are at risk for falling behind their peers and for failing to satisfy the educational requirements of their grade level curriculum (Gunning, 2002; Jenkins, Vadasy, Firebaugh, & Profilet, 2000).Text-reader software, such as Kurzweil 3000 (Kurzweil Educational Systems, 2002), can be used to provide intermediate-grade students with decoding support (Hitchcock, 2001; Ontario Ministry of Education, 2005). Text-reader software provides readers with an audio and visual output of written text. The text is scanned into the software program and is read to the student through the computer system. By reducing the demands on decoding instruction, text-reader software may afford educators with an opportunity to provide learners with focused, explicit instruction in the use of reading comprehension strategies. Research has established that students who receive explicit instruction demonstrate greater learning gains in comparison to their peers who are not provided with such instruction (Ehren, Lenz, & Deshler, 2004). These gains are especially pronounced for learners with exceptionalities (Ehren et al.; Vaughn & Klingner, 2004).

This study was designed to examine intermediate students' perceptions of using the text-reader while simultaneously receiving explicit instruction in the use of evidence-based comprehension strategies, such as question-answering. A qualitative case study allowed for the exploration of participants' experiences with this format of instruction while using assistive technology. The findings of this study add to the research that is available on Grade 7 and 8 students with reading difficulties and their use of assistive technologies as an educational accommodation to enhance their learning capabilities. The findings may enhance educators' understandings about how students perceive assistive

technology as well as increasing their awareness of the technologies available to students with reading difficulties and their potential for assisting these students with the development of reading strategies and skills.

Scope and Limitations of the Study

The scope of this study is limited to those participants who were selected to be part of the study. While this study does not generalize to the overall population of students with reading disabilities, it may allow for further examinations based on the foundational knowledge that has been generated through the completion of the study. This study also provides educators with insights into how students perceive text-reader software and how educators could develop programs to include such technology as part of their curriculum programming. The inclusion of text-reader software in students' educational planning has the potential to benefit students' comprehension of subject materials and enhance their concepts of themselves as readers.

The technology that was used in this study, Kurzweil 3000 text-reader software, can provide beneficial accommodations to many students. Kurzweil 3000 provides students with access to decoded text at any grade level and tools to assist with students' reading comprehension. Unfortunately, one of the limitations of many text-reader software programs, such as Kurzweil 3000 (Kurzweil Educational Systems, 2002), is that not all students have access to it. While text-reader software may be a viable accommodation for many students with reading difficulties, such programs, including the Kurzweil 3000, are expensive to purchase and, therefore, often not always available as an educational accommodation (Marino et al., 2006).

Technologies such as these also require that educators and students have consistent access to computers and be computer literate. Educators and students who are computer literate may be more comfortable with text-reader software than those who are not and may, therefore, use the software on a more regular basis. While the text-reader software only requires basic skills to operate, students who are uncomfortable using technology may find use of the program to be frustrating and uncomfortable. Students and teachers will require training to use text-reader software efficiently (Blackhurst, 2004). Previous studies with college students have found that students and teachers who are provided with training are more successful when using text-readers than students and teachers who have been provided with little or no training before using the technology (Blackhurst; Engstrom, 2005).

Researcher's Perspective

I have worked with children and adolescents for many years as an educator in a multitude of settings. My roles have varied and include peer tutoring, co-op student teaching, educational field trip facilitation, educational camp instruction, working as a teaching assistant, a research assistant, a reading assessor, and an educator in the elementary system. All of these various roles have allowed me to interact with students on different levels and develop and practice instructional techniques and strategies that assist in their educational development.

My interest in students with reading difficulties began in high school. Throughout my undergraduate and graduate years at Brock University, I was able to further develop my knowledge of the theoretical background, assessment processes, current research, and practical professional approaches to reading difficulties. For the past 3 years, I have been

employed as an elementary teacher and have had an opportunity to work with many students, including those with reading difficulties. I have taught many lessons that required numerous types of skills and have often felt that students in the intermediate grades needed more assistance in reading than was being provided. I believe that developments in the use of technology in the classroom provide an opportunity for the integration of assistive technologies for students who will benefit from such accommodations. For students with reading difficulties, text-reader software is a form of assistive technology they can learn to use through instructional programming. This technology can also be used in the classroom setting. It is my belief that assistive technology, such as text-reader software, may provide intermediate-grade level students with reading difficulties with the opportunity to read grade level material and complete assignments successfully and independently.

Outline of the Remainder of the Document

This document examines the study of Grade 7 and 8 students' perceptions and experiences using text-reader software while receiving explicit comprehension strategy instruction. Chapter Two provides an overview of the literature that explains the background to reading difficulties and describes and supports the main components of the study, explicit instruction, reading comprehension strategies, and the use of text-readers as an accommodation for decoding. Chapter Three provides readers with a detailed description of the methodology of the study. Included in this chapter are the rationale for using a qualitative case study methodology and a detailed description of the research that has been conducted. There is also a description of the instructional and data collection instruments that were used. Chapter Four provides case studies for each of the

participants and detailed, evidence supported themes that emerged after analyzing the data collected during the study. The themes are formed by the data and provide the reader with a detailed, data-driven view of the research and the findings. Chapter Five is a discussion of the research, the findings, and the potential impact that programs, such as the one presented in this study, may have upon students with reading difficulties. There is also discussion regarding the need to integrate instruction in evidence-based practices with technology to enhance students' reading comprehension skills. Chapter Five will also provide an overall examination of where the research could continue from here.

CHAPTER TWO: REVIEW OF THE LITERATURE

In this chapter, the research related to the use of assistive technology, specifically text-reader software, in the classroom will be examined. The literature will be examined to establish current understanding of the effectiveness of using of text-reader software for students with reading difficulties and reading disabilities (RD). As part of this chapter, the nature of the reading process, reading difficulties and how the latter can affect students' learning abilities will be defined. An analysis of the research exploring the nature of effective comprehension skills and reading comprehension strategy instruction will be completed. This analysis will include a review of the literature on interventions for students with reading difficulties and will examine how assistive technology can be used to this end. Finally, a rationale will be provided about the importance of this study with respect to the existing research on assistive technology and how this study can enhance the limited amount of literature that is currently available on intermediate-grade students' use of text-reader software. This rationalization provides the reasons for studying how text-reader software can benefit students with reading difficulties when used in combination with comprehension instruction.

Reading Difficulties

Today's world is one of words. Written text surrounds us and is found in multiple formats. As our world becomes increasingly literate, instruction for students with reading difficulties becomes increasingly vital to students' abilities to interact with the text that surrounds them throughout their life (Leu et al., 2004). Students with reading difficulties struggle with the process of reading and/or the comprehension of written text. The

prevalence of students affected by reading difficulties in elementary schools in North America is 15% to 20% or greater (Hallahan, Kauffman, & Lloyd, 1999).

The etiology of reading difficulties is quite expansive. Reading difficulties presumably can be the result of such primary factors as genetic disposition, central nervous system damage, trauma, premature birth, low birth weight, environmental hazards, and low socioeconomic status (SES) (Lerner, 2003; Winzer, 2007). Reading difficulties can also reflect secondary symptoms of a primary disorder, such as a speech and language impairment, a learning disability, or a behavioural disorder, or any combination of these primary and secondary factors (Donahue, Finnegan, Lutkus, Allen, & Campbell, 2000; Lerner; Snow et al., 1998; Winzer). Reading difficulties can afflict both males and females, although reading difficulties occur more often in males than females (Lerner). Reading difficulties are more likely to occur in minority students and those from low SES homes than students who are not part of a minority group and students who are from middle or high SES homes (Donahue et al.).

Students with reading difficulties are often diagnosed with comorbid difficulties including learning disabilities (LD), behavioural disorders, and Attention Deficit Hyperactivity Disorder (ADHD). The most frequently occurring type of exceptionality is LD. In fact, 52% of students with special needs have a learning disability. Within this 52%, the majority (80%) of students have a reading disability and/or experience reading difficulties (Lerner, 2003; Lyon & Moats, 1997). Reading disabilities (RD) are, thus, the highest incidence of exceptionalities and, therefore, should be a primary concern for educators and researchers. RD can cause difficulties in developing the skills that allow for decoding words, word-recognition and automaticity, and reading comprehension

(Lerner). Students with behavioural disorders also tend to have reading difficulties (Cornwell & Bawden, 1992; Kauffman, 2005). Winzer (2007) concluded that students with behavioural disorders have a high prevalence of reading difficulties in addition to academic underachievement in all content areas. Glassberg, Hooper, and Mattison (1999) found that 6% to 24% of students identified with reading disabilities also had a diagnosis of a behavioural disorder. Up to 80% of students diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) also exhibit academic problems in the area of reading (Harris, Friedlander, Scaller, Frizzele, & Graham, 2005). Students with ADHD often demonstrate lower motivation for schoolwork in comparison to their peers and tend to avoid tasks that require self-sustained attention, such as reading, which can lead to reading deficiencies (Winzer).

The prevalence of reading difficulties may be larger than documented due to the comorbidity of reading difficulties and other diagnoses. Students' reading difficulties may be camouflaged by symptoms related to the primary diagnosis. For example, a student with a behavioural disorder may not be provided with remedial reading instruction as treatment may focus on the primary diagnosis - the behavioural disorder. It is possible that a student's reading difficulty may not be identified as the student's disruptive behaviour could potentially interfere with an accurate evaluation of his/her reading ability. Reading difficulties experienced by these students may be viewed as a consequence of the primary diagnosis and, therefore, not included in the statistical count of students who are affected by reading difficulties.

The Developmental Progress of Reading Difficulties

The National Reading Panel (2000) reports that 17.5% of students in North America, or approximately 1 million students, experience reading problems in the first 3 years of school. Torgesen (1997, 1998) found that students who are poor readers in the first grade continue to be poor readers in subsequent grades. Reading difficulties are pervasive and continue to plague students throughout their school years. More positively, providing students with early intervention programs can provide students with the skills and strategies that they require to become more successful readers (Snow et al., 1998). For instance, students with significant delays in early literacy skills benefit from programs that provide instruction in such fundamental skills as phoneme identification, alphabetic-letter correspondence, and print awareness (NRP; Snow et al.; Torgesen, 1997).

Without appropriate intervention, students with early reading difficulties are unlikely to catch up to their peers academically. This phenomenon is generally known as the Matthew Effect (Stanovich, 1986). The Matthew Effect states that poor readers fall farther behind their same-age peers who are good readers because they tend to avoid reading and, therefore, do not gain proficiency or the experiences with text required to become a good reader. Without reading experience, students are not likely to form the basic knowledge base that is required to read. These basics consist of knowledge of text, an understanding of text structure, the idea of finding meaning in print, as well as a motivation to read and learn (Snow et al., 1998).

When students struggle with the reading process, the primary grades are the most effective time for remedial programming and intervention (NRP, 2000; Ontario Ministry

of Education, 2005; Snow et al., 1998). Students who enter the junior and intermediate grades without such programming are especially at risk for continued reading difficulties (Gunning, 2002; Jenkins et al., 2000). Students who enter the intermediate and senior grades without decoding and comprehension proficiency are at risk for not being able to access the texts that are used at higher educational levels (Donahue, Voekl, Campbell, & Mazzeo, 1999). Specifically, these students may struggle with grade-level text, which is the level of text that will be used in conjunction with decoding accommodations in this study.

Since the majority of early language and literacy skill development takes place during the primary grades, the majority of research has been focused on investigating the prevention of reading difficulties and remediation in that specific area. Many students are able to read after completing the primary grades (NRP, 2000). However, students who are entering the junior and intermediate grades without grade-level literacy skills, are likely to fall farther behind as the 'learning to read' curriculum is replaced with the 'reading to learn' curriculum. Intermediate students with reading difficulties are often at least 2 years behind their same-age peers in school achievement levels. These intermediate students lack the opportunities to develop and practice reading and comprehension strategies that their similar-aged peers have gained during their school experiences (Mastropieri & Scruggs, 1997). Lerner (1997) stated that many schools do not offer intermediate and secondary school students courses focused on remedial reading or writing. Rather, most assistance for students at this level is in terms of curriculum accommodations and modifications.

When adolescents with reading problems encounter their course readings, they may develop behaviours that impede their learning (Hasselbring & Gion, 2004). These adolescents frequently display a lack of motivation, possess low self-confidence, and have an array of maladaptive behaviours, such as "skipping classes" (Deshler et al., 1996; Lerner, 1997; Schumaker, Deshler, & Ellis, 1986). Also, adolescence is a time when students are generally struggling with becoming independent, physical changes, sexuality, peer pressure, and self-consciousness (Lerner, 2003). These developmental issues can be compounded with the learning difficulties that these students are already experiencing. This may further impact negatively students' behaviour and impede their learning. These developmental and behavioural issues reflect in students' learning and can further afflict their ability to read. Students with reading difficulties often avoid reading, minimalizing their opportunities to practice and gain fluency skills. This avoidance of reading increases the possibility of students remaining non-fluent readers. Fluent readers can read text quickly and accurately (Fuchs, Fuchs, Hosp, & Jenkins, 2001). Fluency allows for comprehension of text, which is the goal in reading.

Types of Reading Difficulties

Reading difficulties consist of two foundational types: decoding difficulties and reading comprehension difficulties. These two categories of reading difficulties can occur simultaneously or, in some cases, exist independently (Leach, Scarborough, & Rescorla, 2003). Decoding difficulties are at the foundational level of reading. Here, students struggle with decoding the alphabetic symbols, recalling and using the rules of language, pronunciation, and word-recognition (Snow et al, 1998; Torgesen, 1997). Poor decoders generally have a small repertoire of sight words and limited word recall. These

difficulties result in slow, choppy reading that is punctuated with pauses and pronunciation errors (Adams, 1990; Beck & Juel, 1995). Students who have decoding difficulties cannot read fluently and often are unable to gain meaning from the text (NRP, 2000). Fluent readers score higher on tests of text comprehension than students who are not fluent readers (Cooper & Kiger, 2006).

It is generally assumed that junior and intermediate students are able to read fluently, with instruction in decoding no longer part of these students' curriculum. Furthermore, texts written for junior and intermediate students are more complex than primary ones and contain higher levels of reading vocabulary. Generally, the ability to read fluently assists in raising students' comprehension abilities (Barr, Blachowicz, & Wogman-Sadow, 1995; Block & Pressley, 2002; Ivey, 2002). Research has shown that fluency is a prerequisite for good comprehension (LaBerge & Samuels, 1974; Sweet & Snow, 2003). Students have become automatic decoders, therefore, freeing students' cognitive capacities for the comprehension process (LaBerge & Samuels; Ormrond, 1999; Pressley, 2000). The average junior grade reader has a fluency level that is typically much higher than that of a poor decoder in the junior and intermediate grades (Jenkins, Fuchs, van de Broek, Espin, & Deno, 2003). High fluency levels allow for teachers to focus on comprehension instruction rather than decoding instruction.

While remedial decoding instruction can continue at the junior and intermediate levels, students need to learn strategies that will provide them the ability to understand and make meaning from text (Pressley, 2000; Pressley, Brown, El-Dinary, & Afflerbach, 1995; Sweet & Snow, 2003). As part of this focus, students may need to be provided with

accommodations that alleviate the need to decode text (MacArthur, Ferretti, Okolo, & Cavalier, 2001) and allow them to focus on the comprehension of it.

Durkin (1993) refers to reading comprehension as the "essence of reading." Comprehension is simply defined as one's ability to interact with text and extract and construct the meaning from it (Ontario Ministry of Education, 2005; Sweet & Snow, 2003). Comprehension is reliant upon the combination of decoding ability and language understanding (Gough & Tunmer, 1986). Language comprehension is also known as listening comprehension (Catts & Kamhi, 2005; Gough & Tunmer; Hoover & Gough, 1990), which is defined as the ability to take meaning from text after listening to it read aloud (Williams, 2002). In general, students with reading difficulties have higher listening comprehension abilities than reading comprehension abilities (Williams). Listening comprehension is related to a student's ability to process information and recall information from memory. This can be more difficult for students with cognitive processing deficiencies than students who are able to read at grade level (Aarnoutse, van den Bos, & Brand-Gruwel, 1998). However, having to decode text and comprehend can result in lower comprehension scores than when a student is not required to decode text (Aarnoutse et al.). For intermediate-grade students who struggle with decoding, alleviating their decoding difficulties may allow them to use their listening comprehension abilities and learn to apply comprehension strategies to improve their understanding of text. These findings are relevant to this study as participants will incorporate their listening comprehension skills with learning to apply comprehension strategies.

While decoding ability and language comprehension are the foundations of gaining meaning from text, proficient readers develop a repertoire of skills and abilities that enable them to become good comprehenders. Snow, Sweet, Alvermann, Kamil, and Strickland (2001) compiled a list of the characteristics of good comprehenders. These characteristics include the cognitive capacity, vocabulary, domain, and topic knowledge, motivation, and purpose. They also reported that students must be able to make inferences from text, critically analyze information, use visualization and imagery, and summarize information (Snow et al., 2001). Proficient readers are able to integrate text information with their general knowledge of the topic as well as their relevant life experiences to glean meaning from it (Anderson & Pearson, 1984; Ontario Ministry of Education, 2005).

Good comprehenders possess proficiency in lower order (i.e., word-level) and higher order (i.e., mental imagery) processes (Pressley, 2000). While difficulties in comprehension are often related to poor decoding skills (NRP, 2000), students can suffer from comprehension difficulties that are the result of other cognitive processing problems such as slow speed of information processing (Berninger, Abbott, Billingsley, & Nagy, 2001). Readers may also have trouble with the cognitive processes of recognizing the message of the text and identifying the need to use strategies to address the problems that they are encountering in making meaning out of the text (Barr, Blachowicz, Katz, & Kaufman, 2002).

Good readers have been found to use comprehension strategies automatically (Pressley & Afflerbach, 1995). These strategies are applied before, during, and after reading and assist in the construction of the meaning from text. Many of these strategies

are higher-level information processing skills, such as establishing a purpose and plan for their comprehension of text, applying multiple strategies during reading, using knowledge of strategies to determine appropriate strategy application, and monitoring comprehension (Fisher et al., 2002; Pressley, Borkowski, & Schneider, 1990). Fisher et al. (2002) reported that students with comprehension difficulties lack these higher order information processing skills. Reading comprehension skills are built upon successful prereading and early reading instruction including accurate and rapid word recognition and good oral language skills, skills that poor readers often lack (NRP, 2000; Snow et al., 1998). Poor readers also benefit from explicit strategic instruction in the use of comprehension strategies and extensive practice using these strategies, leading some researchers to advocate that students with reading difficulties be provided with such instruction across all subject areas (Duffy, 2002). Collectively, these findings are relevant to this study as participants here received explicit strategic instruction in learning to apply higher-order reading comprehension strategies to gain meaning from grade-level texts.

Comprehension Strategies and Strategy Instruction

The remediation of intermediate students' reading comprehension skills and the strategies, accommodations, and interventions that are available to them are outlined in the remainder of this chapter. Researchers have found that intermediate students can benefit from explicit instruction in the use of comprehension strategies and that effective instruction emphasizes the metacognitive components of strategy use and the goals of reading (Brown, 2002; Palincsar & Brown, 1984; Paris, Wasik, & Turner, 1991). Students need to be provided with explicit instruction in the use of evidence-based reading comprehension strategies so that they understand how, when, and why to use

each strategy (Block, Gambrell, & Pressley, 2002). Students need to possess a repertoire of comprehension strategies and be able to recognize when to use them (Block et al.). Adolescents who struggle with reading are unlikely to possess such relevant comprehension strategies partially due to decoding difficulties and instructional emphasis on these processes (Fisher et al., 2002). The continued explicit instruction of comprehension strategies throughout the intermediate grades is needed in order for students with reading difficulties to gain proficiency in strategy use.

Educators also need to use differentiated instructional techniques in order to ensure that all students have the opportunity to learn and apply knowledge presented in every lesson taught. Differentiated instruction (DI) is teaching the same curriculum to a diverse group of learners at a variety of levels using multiple teaching and learning modes (Tomlinson, 2000). DI is based on the idea that students learn in a variety of ways and have various levels of background knowledge and educators must acknowledge these differences and provide instruction that will benefit all students equally (Tomlinson, 1999, 2000). Differentiated instruction provides learning environments that can engage all students in successful learning activities. Providing explicit instruction, which is discussed in the following section, in comprehension strategies can allow for a variety of learners to understand and apply learning strategies, as it provides all information required to learn to use strategies, therefore, highlighting the foundations of DI. Explicit instruction utilizes the DI approach as it reaches all students, whether students are aware of the strategies before instruction or have no or very little background knowledge of strategies (Thames et al., 2008).

The National Reading Panel (2000) outlines seven strategies that have been demonstrated to improve students' reading comprehension abilities including comprehension monitoring, cooperative learning, use of graphic and semantic organizers, question answering, question generation, story/text structure, and summarizing (NRP, 2000; Sweet & Snow, 2003). While substantial evidence exists demonstrating the effectiveness of each of these seven instructional strategies, comprehension monitoring, prior knowledge activation, and the use of question generation are the strategies that are most relevant to the study described here and, thus, are described next.

Comprehension Monitoring and Explicit Instruction

Comprehension monitoring encompasses students' metacognitive awareness associated with their use of strategies to comprehend text. Metacognition is an awareness of one's knowledge and use of strategies that aid in planning, monitoring, and controlling one's learning (Reutzel, Camperell, & Smith, 2002). Good readers are aware of what they comprehend and what they do not comprehend, monitoring the need to apply appropriate strategies. These students also have the ability to judge the difficulty of the cognitive demands of a text. They can decipher the need for a certain strategy depending on the difficulty of the text, the constraints of the situation, as well as their own cognitive abilities (Dole, 2000; Duffy, 2002; Duffy et al., 1987). These are vital skills for all students to develop, especially those with reading difficulties. In part, students' ability to develop metacognitive awareness depends upon their understanding and use of strategies. Good readers will identify when a text is unclear or when they need to have a deeper understanding of the text and they will apply appropriate strategies based on their needs (Bunting et al., 1987, cited in Keene, 2002). Keene reports that good readers are able to

identify the degree to which they understand text and the processes that they can use to acquire meaning from it. They can identify their purpose for reading and can learn strategies from observing modelled strategy applications.

Effective comprehension strategies that are dependent upon students' metacognitive awareness include automatic activation of prior knowledge before, during, and after reading (Keene, 2002; Pearson, Roehler, Dole, & Duffy, 1992); identification of the main ideas and themes (Afflerbach & Johnston, 1986; Keene); questioning (Palincsar & Brown, 1984; Rosenshine, Meister, & Chapman, 1996); and summarizing (Keene; Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989). Good readers will automatically recognize the need to use a strategy and will apply it, while poor readers are unlikely to recognize their need to use a strategy (Block, 2001). Poor readers need instruction in developing a repertoire of strategies and the metacognitive processes of using them. They need the repetitive practice of applying the strategies that lead to successful reading experiences and these strategies need to be taught in all subject areas so students can apply them to a large variety of texts (McGee, 1982; Pressley, 1998).

Providing students with the rationale associated with the use of individual strategies and modeling the thinking processes while using each strategy, or what is otherwise known as explicit instruction, is one instructional method known to improve students' metacognitive understandings (Block & Pressley, 2002; Fisher et al., 2002; Woloshyn, Elliott, & Kaucho, 2001). Explicit instruction provides students with a demonstration of strategies in action and guides students in gradually internalizing the strategy and independently being able to apply it (Duffy, 2002). Educators use this technique to provide students with concrete examples of the process of using strategies to

aid in comprehension. Students are guided through a think-aloud process where the teacher actively engages in using a strategy, verbally describing all cognitive actions that are occurring and why they have selected the strategy being demonstrated. The demonstrated strategy is not broken into subsets of skills, but is taught as a whole (Dole, 2000). Dole found that explicit teaching is reliant upon educators' effective teaching processes that will aid in the activation and development of students' metacognitive ability. This instructional technique does not assume that students have mastery of skills and does assume that students will have a variety of background knowledge and strategic abilities (Dole; Pearson & Dole, 1987). These assumptions highlight the specific reasons why explicit instruction is applicable to students with reading difficulties.

In a review of implicit and explicit instruction of struggling readers, Duffy (2002) claimed that students with reading difficulties do not recognize the subtle cues in implicit instruction. Duffy found that readers who struggle with the foundational skills of reading need to have the explicit teaching of more complex concepts of reading comprehension. In an earlier study, Duffy et al. (1987) found that students with reading difficulties who were provided with explicit instruction made higher gains in reading and applying strategies than a control group who were provided with traditional instruction that was based on implicit instructional techniques. More recent research supports Dole's (2000) findings that explicit instruction of comprehension strategies is more effective in enhancing students' reading comprehension abilities than traditional instruction (Van Keer, 2004). Van Keer found that students who were taught reading comprehension strategies explicitly scored higher on reading comprehension tests than those who were taught strategies using a traditional instruction method. Overall, these findings support

the use of explicit instruction in this study when working with students with reading difficulties to adopt higher-level reading comprehension strategies.

Prior Knowledge

Prior knowledge greatly affects students' reading comprehension. Proficient readers activate prior knowledge before reading, connect text knowledge with prior knowledge, and replace inconsistent and/or incorrect prior knowledge with new information. In other words, proficient readers automatically call upon their prior knowledge to enhance their learning (NRP, 2000). However, students with reading difficulties often need explicit instruction in learning to activate and use their prior knowledge (NRP). Researchers have demonstrated that students with learning and reading deficits also tend to have low topic knowledge and lower word knowledge (Keene, 2002). Students who have reading difficulties tend to have fewer experiences with literature which can result in lower world knowledge and lower vocabularies than the average reader. Keene's review of the research claims that students with low topic knowledge answer fewer inferential questions in classrooms and recall less of the information from texts than students who have higher topic knowledge. Low background knowledge, whether lacking or not applicable, influences students' reading comprehension. Good readers use their prior knowledge to understand what they are reading and elaborate on knowledge gained from text (van den Broek & Kremer, 2000). They also use this knowledge to make connections within the text, which increases recall of the text information, and to generate questions when they encounter confusion (Pressley, 2000; van den Broek & Kremer). Vocabulary acquisition also influences students' ability to comprehend text (Graves, 2000). Students gain large word knowledge

from exposure to a multitude of literacy materials (Anderson, 1996). Students with reading difficulties tend to have smaller vocabularies than good readers (Anderson; NRP). This form of prior knowledge assists in students' understanding of a text at the word-level. It is imperative that students understand the majority of the words within a text in order to glean meaning from it (Vellutino, 2003). In context and out of context vocabulary instruction that focuses on new or complex words can assist all students with a greater understanding of what is being said within the context of the readings (Graves).

Use of prior knowledge to assist students in acquiring meaning from text is a vital strategy that good readers use automatically as they develop in reading skill. Many students with reading difficulties do not activate prior knowledge spontaneously. Pressley and Wharton-McDonald (1997) reported that students with reading difficulties who have the same amount of prior knowledge as an average reader are more passive in their reading and less likely to apply their knowledge to elaborate or expand upon text. Students with reading difficulties and inexperienced readers need to be instructed in how to activate and use their prior knowledge to make meaning from text (Pressley & Wharton-McDonald). Students will also need instruction in adjusting their prior knowledge if it is contradicted by the text (Pressley & Afflerbach, 1995). In these situations, students may disregard what they have read if it is inconsistent with their prior knowledge. Students may need guidance in understanding that their prior knowledge can be replaced as they learn more about a topic from a text. In this study, participants were provided with explicit instruction in how to activate and use prior knowledge. Participants also were provided with instructor-led modelling of prior knowledge

activation as part of using a question-answering strategy. The modelled instruction also provided examples of when text knowledge replaced erroneous prior knowledge.

Educators are encouraged to prompt students to activate their prior knowledge before reading. This may be done with strategies such as guided discussions, the generation of a Know, Wonder, Learn (K-W-L) chart, and prediction exercises. A K-W-L chart is a visual organizer that allows students to activate their prior knowledge, generate questions before and during reading, and record new knowledge during and after reading. These processes provide the opportunity for students to form connections between previously learned knowledge and the new information. This will assist in students' ability to store the information as it has become interconnected with previously stored knowledge (van den Broek & Kremer, 2000). Educators need to be selective with how they choose to activate knowledge so that the proper knowledge is triggered. Proficient readers have a more selective and restrained process of activating prior knowledge than poor readers do (van den Broek & Kremer; Zwaan & Brown, 1996). Zwaan & Brown found that this selective process makes proficient readers' prior knowledge activation more effective. Martin and Pressley (1991) found that activating relevant prior knowledge before and after reading aids in greater retention of facts when compared to students who do not activate relevant prior knowledge.

Instructional strategies that activate prior knowledge include prediction based on text and text features, question elaboration, question generation, and question answering (NRP 2000). The NRP found that research supports using memory recall discussions to activate prior knowledge before reading. Teachers can assist in students' activation of prior knowledge using prompt questions that focus on main ideas from the text they are

reading. Students can use their world knowledge to recall knowledge that they have stored on the topic being discussed. Also, students who make predictions based on text cues also activate their prior knowledge in generating their predictions and in explaining the reasoning behind predictions. Question generation and question answering are two other strategies that can activate students' relevant world knowledge, and this can occur before, during, or after reading (NRP). Using strategies, such as question generation and question answer during and after reading, will assist readers in generating connections between prior knowledge and new information and enhance their abilities to recall information contained in text (Keene, 2002; King, 1992). When instructing students with reading difficulties, explicit instruction in these strategies needs to include explanations of when to use the strategy as well as why it is used (Pressley, 1998). Students with reading difficulties need to make the connection between the strategies that are being taught and how these strategies can enhance reading comprehension. Educators can teach poor readers to engage in active reading and activate their prior knowledge through such techniques as prereading discussion, KWL charts, and before reading questioning (NRP). This study used the techniques discussed to explicitly teach participants how to use their prior knowledge to increase their reading comprehension.

Questioning, Question Generation, and Question Answering

Question generation and question answering are strategies that allow teachers to use the text to enhance students' critical thinking skills and recall abilities (King, 1990, 1992; NRP, 2000). These strategies provide students with the opportunity to activate and expand upon their prior knowledge with new knowledge gained from text, then manipulate the knowledge that they gained from a text and apply it to an inquiry or to

form questions of their own (King, 1992; NRP). This works on a continuum, with students constantly acquiring more world knowledge references as they read and apply question strategies that aid in higher level comprehension of text.

Questioning is a form of elaboration that encourages students to make reference to their prior knowledge, develop questions about unfamiliar parts of a text, and identify information that needs to be reread or requires further investigation (King, 1992; NRP, 2000). Questioning is also a form of elaboration that increases students' ability to understand and remember new information (King, 1992; Pressley et al., 1997). The simplest forms of question and answer are found in classroom discussions surrounding texts. The questions are most often posed by teachers to students and used to generate class discussions or to form comprehension worksheets on texts. The NRP (2000) found that students generally need instruction in answering questions as they do not instinctively know how to answer questions, no matter who the questioner is (i.e., self, teacher, or peer). Simple question and answer discussions before, during, and after reading can be more effective when students are taught how to answer a question by identifying what type of information the question is asking for (NRP). Students who can identify the type of question (e.g., inferential, literal, or critical-thinking) may be more successful at providing an answer (NRP).

Generating questions is another way that provides students with the opportunity to become more engaged with the text and develop better memory representations of the information from texts. Providing students with questioning prompts is one technique that encourages them to develop specific thought-provoking inquiries regarding the information found in the text and rational explanations for their thinking. Questions can

aid in the development of critical–thinking skills, especially if students are encouraged to develop various levels and types of questions.

In her seminal work, King (1990, 1991, 1992, 1995) reports on how instructing students to generate memory and thinking questions using question stems while reading improves their learning of text. Memory questions require students to return to the text in order to develop an explanation for their inquiry while thinking questions require students to go beyond the text to make inferences and/or provide explanations. King (1992) reports that while generating questions alone stimulates critical thinking, elaborating on a question through answering the generated questions provide students with greater benefits. When students are asked to generate questions, they often produce memory questions that require only factual recall skills (King, 1995). In order to produce critical thinking questions that engage students in high-level cognitive processes, King (1995) reports that educators must instruct students in the production of higher-level question generation. High-level cognitive questions prompt the use of analysis, inference, evaluation, and compare and contrast skills, which are all high-level cognitive processes, requiring students to engage in more in-depth thinking and relating of prior knowledge to newly acquired knowledge. King (1995) has also found that this form of questioning serves a metacognitive role and induces students to become aware and to monitor their thinking, which provides students with greater control over their thinking abilities and can enhance their skills in applying strategies. These results are comparable to a similar strategy that emphasizes the use of self-questioning, which involves readers posing questions to themselves while reading, which was shown to improve students' reading comprehension when compared to students who used other strategies (Wong, 1985, cited

in King, 1991). King (1992) found that the generated verbal elaborations stimulated by the thought-provoking questions led to improved comprehension in a variety of readers including poor readers and average readers. These questions also stimulate students' prior knowledge, which increases their ability to make interconnections between new and old knowledge, thereby increasing students' ability to recall new learned information (King, 1992; Martin & Pressley, 1991).

King (1990) found that students who were provided with instruction in using question stems to form thought-provoking questions had more elaborate explanations and performed higher in a comprehension test than students who did not. Question stems provide students with the structure and guidance needed in the development of high-level questions. Question stems provide exemplars of thought-provoking questions and will induce critical thinking skills of the questioner and the responder (King, 1995). King found that the use of question stems in a supported environment provided students with an environment and materials to enhance their question generation skills quicker than without such support (King, 1990, 1992, 1995). Question stems are applicable to different types of instructional and learning settings, including individual application, small group work, and large group discussions (King, 1995). Multiple types of groupings can further enhance the use of questioning (King, 1992, 1995). Students may read text and generate questions and answer individually, then form small groups to further discuss questions. Discussions can prompt new answers and further follow-up questions that expand upon the first question, stimulating further in-depth thought on the text material (King, 1995). Questioning has been found to be effective in multiple age groups, from intermediate elementary grades to university students, and in various subject areas including

mathematics, science, English, and cognitive psychology (Chen & Bradshaw, 2007; King, 1990, 1992, 1995; Kramarski, 2004)

The benefits of using question-answering strategy are increased when the strategy is taught explicitly to students (King, 1992; Pressley, 2000). Modelling of question generation before, during, and after reading can provide students with the concrete demonstration of the thought-process used during question generation (Hervey, 2006). Educators can guide students into becoming more automatic in questioning text by providing explicit models of the process and through direct explanation of why questions can enhance reading comprehension (Hervey). Hervey states that teachers must teach students to be accountable for the questions that they generate and pose questions that will enhance their learning. Based on these findings, an explicit instructional program was created to teach participants to use the question-answering strategy to enhance their reading comprehension abilities.

Informational Text

In order to effectively develop students' reading comprehension abilities, educators must use a variety of teaching strategies (NRP, 2000). Students need to be aware of when and where to use each strategy. For students with reading difficulties, the instructional strategies may need to be combined with other forms of accommodations, such as graphic aids and organizers or text-readers (MacArthur et al., 2001). For intermediate students, they require instructional periods on how to comprehend materials from their content course texts. Informational texts have been found to be more difficult for students to comprehend than narrative text (Block et al., 2002; McGee, 1982). This effect is found to be even higher in students with reading difficulties who may have less

prior knowledge due to a lack of experience with reading materials (Keene, 2002; Pressley & Wharton-McDonald, 1997).

Smith (2000) found that the majority of reading that adults engage in daily, both for work and pleasure, are informational texts. This was also found to be true for students after completing the primary grades (Snowball, 1995, cited in Ogle & Blachowicz, 2002). The internet has become a large supplier of informational text, providing new digital forums, such as on-line magazines, digital newspapers, blogs, chat rooms, and other digital information sites. These new types of literacy increase the need for students to develop good comprehension strategies in order to process all of the literacy materials they encounter at school and in their daily lives (Leu et al., 2004). Beginning in the junior grades, educators are being encouraged to integrate these new sources of informational text and to use the abundance of text available on the internet to their students' advantage.

While educators are expected to instruct students in skills to glean knowledge from this abundance of informational text, there is also a shift in the content of the language curriculum for junior and intermediate grades. Specifically, the focus of the language curriculum moves from having students learn to read and write to having them read and write in order to learn about the world around them, communicate their learning to others and apply their knowledge in real-world settings. The junior and intermediate grades are the grades where reading is no longer taught but is the primary process by which new knowledge is acquired. Students need to read proficiently in order to understand and acquire grade level curriculum (Alvermann & Moore, 1991). Much of the reading that takes place during the intermediate grades is self-directed and requires the

students to be motivated to engage in active, independent reading (Brown, 2002). While educators may recognize the importance of teaching students comprehension strategies in order to encourage them to become fluent and comprehensive readers, many intermediate students with decoding difficulties are unable to engage in such practice and, thus, do not become proficient in using these comprehension strategies. These students require opportunities to experience reading without overly focusing on decoding. In this manner, they may be able to acquire the strategic processes and metacognitive awareness that good readers possess (Brown). In order to do this, these students may benefit from assistive technologies that aid in the decoding process and free up mental capacity for the application of comprehension strategies (Balajthy, 2005; Blackhurst, 2004; Hasselbring & Bausch, 2005; Hecker et al., 2002; Marino et al., 2006). Specifically, assistive technology, such as text-reader software, can be used to provide intermediate-grade students with decoding support (Hitchcock, 2001; Ontario Ministry of Education, 2005). This study provided intermediate students with the opportunity to receive explicit instruction in reading comprehension strategies while being provided with text-reader software to compensate for decoding difficulties.

Assistive Technology (AT)

The Individuals with Disabilities Education Act (IDEA) defines assistive technology (AT) as "any item, piece of equipment, product or system, whether acquired commercially off the shelf, modified, or customized that can be used to directly assist, maintain, or improve functional capabilities of individuals with learning disabilities" (U.S. Department of Education, p. 20). The research suggests that AT is effective when there is a good match between students' ability levels and the technology that they are

provided with (Mancini, Gagnon, & Hughes, 2002; U.S. Department of Educations, 2004). AT requires instructional time so that students are able to understand the technology and receive the maximum benefit from using it. AT is not to be used as a crutch but rather as a way to assist students in overcoming their learning problems so that they are able to learn more effectively (Learning Disabilities Association of Canada [LDAC], 2003). AT provides many benefits for people with reading difficulties. AT can help individuals with reading difficulties to be more independent and can provide a greater selection of choices in reading material. These technologies provide opportunities for students of all ages to experience success and can provide them with greater independence (Hecker et al., 2002). This independence can increase students' confidence and self-esteem, thereby, improving their quality of life and removing some of the barriers to achievement (LDAC).

In a survey conducted by Burton-Radzely (1998), 97% of Special Education teachers in North America indicated they believe that technology can assist students in acquiring literacy skills. Technology for students with special needs is becoming prevalent in almost all schools in North America (Matthews, Pracek, & Olson, 2000, cited in Mancini et al., 2002). While technology may benefit all students, it has the potential to have the largest impact on students with special needs as it can accommodate for students' exceptionalities in learning (Mancini et al.). AT can remediate the difficulties students encounter that impede their learning, such as a text reader accommodating for a student's poor decoding while reading.

AT can be incorporated into students' remedial and instructional program plans. It is vital to make intermediate and senior students' remedial programming interesting and

applicable to their lives (Hasselbring & Gion, 2004). For example, if an educator were to set up an AT program for a student with reading difficulties, he/she would have to take numerous issues into consideration. According to Hasselbring and Gion (2004), the programming for including AT used to assist students' with reading difficulties must address four issues. First, the reading program used must be rewarding and intrinsically motivating. Second, the program cannot be noticeably different from what other students are completing. Third, students need to be able to complete some of the tasks independently and be able to feel as though they have some control. Finally, the reading program must incorporate students' strengths and provide them with successful accomplishments in order to encourage them to continue with it. Incorporating an AT as accommodation in educational settings, such as text-reader technology, can motivate students to become more engaged with the text and also alleviate the anxiety related to decoding (MacArthur et al., 2001). MacArthur et al. qualify that incorporating text-readers can allow students to enjoy reading while gaining content and vocabulary knowledge, practice their developing comprehension strategies, and participate in the same curriculum content as all other students in their grade level.

Text-Reader Software

Text-reader software, such as Kurzweil 3000 (Kurzweil Educational Systems, 2002), is an AT that has been commonly used with older students with disabilities, from the junior/intermediate grades to postsecondary students. While there are many other types of text-reader software (e.g., Kurzweil 3000, Premier Tools, Natural Voices, Power Text Reader, etc.), Kurzweil is the software package used in this study and the focus here. Beyond text-to-speech recognition, Kurzweil provides readers with many additional

tools such as "sticky notes" Text-reader software is often used as an accommodation for students' decoding limitations. Students with reading difficulties need extensive practice reading and interacting with text with the goal of deriving meaning from connected text and to assist in developing fluent reading abilities (NRP 2000; Pressley, 1998). It is hypothesized that students in the higher elementary grades who still require extensive practice to achieve fluency in reading may benefit greatly from having a text-reader made available to them. This is especially true when they are required to read grade level or above text (Fisher et al., 2002). Text-reader software is an available option that can compensate for poor decoding skills and assist people with reading difficulties to make difficult texts more accessible.

Most text-reader software includes features that allow students to apply reading and comprehension strategies while listening to text. These features include synchronized visual and auditory presentation of the text and adjustable reading voice and speed. In addition, the software includes electronic dictionaries and study/reading tools that aid the user in employing reading strategies while actively engaging with the text (MacArthur et al., 2001). Students using this technology should receive training in how to use the program effectively because it is more than just a "reader." This program allows students to implement comprehension strategies by using the tools available within the program. Combining training sessions in using these tools, as well as comprehension strategy instruction, could make this assistive technology tool more efficient. Such a combined program was the focus of the study described here.

Researchers have found that intermediate students with reading difficulties use their short-term memory capacity to hold and retrieve the knowledge needed to decode,

therefore lessening students focus on comprehension of text. In comparison, good readers are able to decode automatically, therefore, leaving their short-term memory available to process and comprehend the text (Baddeley, 2003; Ormrond, 1999). Text-readers could alleviate poor decoders from this short-term memory overload and leave the memory capacity free to hold the information found within the text instead (Baddeley; Ormrond). It also provides students with the opportunity to gain experience using metacognitive comprehension skills as they are no longer focusing on decoding the text, which can be a difficult and frustrating task for them.

Educators also need to have professional development in AT in order to understand it and incorporate its use into students' program plans. Blackhurst (2004) states that professional development that develops teachers' knowledge about and skill with AT is vital for the teachers to provide effective instructions to the students using it. According to Hasselbring and Bausch (2005), many teachers are not using AT as part of their accommodations and/or modifications for students with LD/RD because they are largely unaware of the types of AT available. As more research is completed investigating the effects of AT in the classroom, more information is being made available to educators regarding the types of AT that benefit specific learning needs. For instance, Marino et al., (2006) created a guide to writing an individualized education plan for students with exceptionalities such as reading difficulties. In addition, Balajthy (2005) has written an academic article based on teachers' perceptions of text-reader software and provides educators with descriptions of the different types of programs available and what each program offers to educators and students.

Learning Gains Associated with Text-Reader Software

Studies exploring assistive technology, including studies on text-reader software, have recently become more popular among educational researchers. The research literature on AT has established an understanding of the gains associated with its use. Many of these studies have used college students with reading difficulties as their participants (Elkind, 1998; Engstrom, 2005; Hecker et al., 2002; Higgins & Raskind, 1997). Some of these studies focus specifically on students with ADHD and reading difficulties (Elkind; Engstrom; Hecker et al.; Higgins & Raskind). However, there is limited information on other age and grade populations and their use of text-readers as an accommodation. This has provided limited research in the area of assistive technology that is relevant to the present study. However, the research that is available does assist in developing the foundation for this study. It is reviewed in order to establish a hypothesis on how intermediate students could benefit from the use of text-readers and the impact that the AT could have on the students' reading comprehension skills.

Engstrom (2005) studied students at Landmark College and found that college students with reading difficulties are better able to understand and process the text presented when provided with supportive active reading and writing instruction along with the use of text-reader software and visual organizational software. The students' performances were compared to their pretest scores taken during the first semester when they did not have access to text-readers and visual organizational software. Students were provided with instruction known as "active reading" that includes teaching students prereading skills, highlighting, margin note-taking, chunking sections of text, and summarizing the text. Students used the Kurzweil 3000 program software tools to

highlight, separate (also known as chunk) text into smaller sections, generate margin notes, and read summaries created in word-processing software. The students were taught the active reading strategies during their first lesson and it was then reinforced in all following lessons. Also, during the first lesson, students were provided with instruction in how to use text-reader software. Students were also provided with word-level instruction, providing them with vocabulary instruction specific to the texts that they were reading. Engstrom concluded that using the text-reader enabled students to approach the multifaceted process of reading with more confidence and allowed them to focus on the comprehension of the text rather than the rapid and fluent decoding of the words within it.

In an independent study, Hecker et al. (2002) examined whether having college students who had been diagnosed with attention disorders and experiencing reading difficulties use text-reader software to complete reading assignments and tests in an English course improved their learning over the Fall semester. The students were trained in the use of text-reading software (e.g., Kurzweil 3000). Comparisons were made between learning following normal, unassisted reading in the first half of the term and assisted reading in the second half of the term. The data that were collected from the group included measures of attention and distractibility, reading speed, comprehension scores, and reading attitude.

Hecker et al. (2002) found that most students read for longer times and reported fewer distractions when using the Kurzweil text-reader. While the reported instances of distractibility was not significant between the two types of reading programs, students who were most distracted during unassisted reading reported the highest amount of

reduction of distractions while using the text-reader software. Furthermore, students reported that they were able to reduce the time they spent reading and their stress level significantly when using the Kurzweil technology. Students with the lowest reading rate were found to have the greatest increase in reading rate when they used the text-reader software.

Surprisingly, Hecker et al. (2002) found no difference between students' comprehension scores following the unassisted and assisted reading sessions. The researchers attributed students' high comprehension to their simultaneous enrolment in a course that explicitly taught them how to apply comprehension strategies when reading expository articles. These strategies would be applied whether a student was using a text-reader or decoding independently. When the study was complete, 11 of the 16 students left in the study continued to use the Kurzweil assistive text-reader for the English course and eight students used the assistive text-reader for other courses as well. The findings of Engstrom (2005) and Hecker et al. (2002) emphasize the importance of providing students with continued comprehension instruction while using assistive technologies. Technology is only a tool; it is the quality of instruction that determines how well that tool can be used (Hasselbring & Bausch, 2006).

Higgins and Raskind (1997) examined 37 postsecondary students with LD use of a text-reader and reported similar findings to Elkind's (1998) study. Students with severe LDs benefited the most from using the technology. Higgins and Raskind measured students' reading comprehension abilities unaided and aided with a text-reader. Students who were the poorest readers, in terms of achieving lower scores on the comprehension

tests, benefited more from the use of text-reader software than students who scored higher on the unaided comprehension tests.

In a study that reports similar findings to Higgins and Raskind (1997), Elkind (1998) studied the effects of using text-reader programs on postsecondary students' reading speed, comprehension, and reading endurance. The participants were 26 students who had all been diagnosed with a learning disability and attended a community college in California. Each student was interviewed and completed numerous cognitive functioning and diagnostic tests. Students received approximately 1 hour of training on the Kurzweil software. Students' comprehension abilities were tested with and without the assistance of the Kurzweil software. Elkind found that using text-readers, such as the Kurzweil software, can improve the reading rate and comprehension of students with LDs. Furthermore, text-readers can increase the duration of time that students with LDs can sustain their attention to text passages. Students in the study reported that they found reading with a text-reader to be less stressful and less tiring than reading on their own. The students who were found to have the most improved scores on comprehension were students with good oral language skills and could integrate audio and visual information well. These students had poor decoding abilities and slower than average word per minute reading rates as well as poor comprehension scores.

These studies on college students (Elkind, 1998; Engstrom, 2005; Hecker et al., 2002; Higgins & Raskind, 1997) were done with very specific and small populations which makes it hard to generalize to other learners. Specifically, many of these students attended a college for students with learning difficulties dedicated to helping them develop their literacy skills. Furthermore, these students were aware of the nature of their

learning disabilities and were focused in acquiring relevant learning strategies. Unlike these students, many students with reading disabilities are at risk for school drop out (Daniel et al., 2006) and are not able to advocate for themselves successfully. These factors may interfere with the role that AT could play in younger students' learning. In order to assess how elementary and secondary students with reading difficulties would respond to using text-reader software, research would need to be done within the general elementary and secondary school populations.

Elkind, Black, and Murray (1996) investigated the characteristics of learners with LDs who benefited from the use of text-readers. A study that they had conducted earlier with intermediate grade students found that some students made substantial gains in reading comprehension scores when they were able to use a text-reader; however, other students' scores decreased when they were provided with a text reader (Elkind, Cohen, & Murray, 1993). Elkind et al. (1996) concluded that not all students with reading difficulties benefit from this technology. Following an examination of adults with dyslexia, Elkind et al. (1996) reported that those with the lowest comprehension scores, and the lowest timed and untimed unaided reading rates, benefited the most from the aid of a text-reader. That is, students who were more proficient readers did not seem to benefit to the same extent as their peers with identified reading difficulties (Elkind et al., 1996). This finding was also reported in Elkind's (1998) study of college students' use of text-reader software to remediate decoding difficulties. This research needs to be further investigated in order to establish the validity as the studies being compared use different age-level populations. While both sets of participants have similar diagnoses, the results would be substantially more reliable if other researchers could validate the findings with

similar results. The results also may be dependent on the type of instruction received and the amount of instructional time that students receive using the text-reader software as well as additional instruction in applying reading skills to the text presented by the text-reader. Successful use of the text-reader may be dependent upon the level of instruction students receive and the knowledge of the instructor of combining reading instruction with AT instruction.

Montali and Lewandowski (1996) found that intermediate grade students' reading comprehension can be improved with bimodal text presentation, where text is both visually and audibly provided. Montali and Lewandiwski worked with two groups of Grade 7 and Grade 8 students: one group of students with diagnosed LD and another group without learning difficulties. Both groups of students were provided with readings in three conditions: (1) visual where students read the text passage off a computer screen; (2) auditory where students listened to a recording of a text passage; and (3) bimodal where students viewed a text passage on the computer screen as it was highlighted and read out loud. Students with LD were found to have greater comprehension in the bimodal condition in comparison to the comprehension scores of students with LD in the other conditions. Their comprehension of text was comparable to students with average reading abilities. This study found similar results to Elkind (1998), Engstrom (2005), and Higgins and Raskind (1997), reporting that text-reader software may improve the comprehension of struggling readers, especially those with poor decoding and phonological awareness skills. These findings support the current study's use of text-reader software with intermediate-grade students with reading difficulties.

Disseldorp & Chambers (2002) recruited 34 intermediate students to participate in a study designed to assess the effects of text-readers on intermediate grade readers of various abilities. Researchers assessed the reading ability of each participant. Following this, students were randomly assigned to one of two groups. The experimental group was provided with text-reader software to read the text while the control group was asked to read the text to themselves. Both groups were provided with the same grade level text to read. Participants were asked to complete a comprehension test on the text when they had completed the reading. In support of Elkind (1998) and Higgins and Raskind's (1997) findings, Disseldorp and Chambers found an average of 7% improvement in reading comprehension scores, with the poorest readers (those with the lowest decoding scores) benefiting the most.

Out of the studies that have been conducted on text-reader software, the majority of those highlight the benefits of using text-readers with students in highschool and postsecondary institutions, although some studies criticize text-reader software as a crutch for students arguing that they allow students them to "give up" on learning how to decode (Edyburn, 2003; Rapp, 2005). These authors (Edyburn; Rapp) recommend that students be taught how to use text-reader software as well as how to use the tools that are included with text-reader software. Rapp stated that proper instruction will guide students to use the software to further develop their literacy skills and become more efficient readers.

The Rationale behind Further Research on Text-Readers

By eliminating the need for decoding instruction, text-reader software may afford educators with a unique format for providing learners with focused, explicit instruction in

the use of evidence-based reading comprehension strategies. It is well established that students who receive explicit instruction demonstrate superior learning gains compared to their peers who are provided with either implicit strategy instruction or no strategic instruction, with gains being especially pronounced for learners with exceptionalities (Ehren et al., 2004; Swanson & Deshler, 2003; Vaughn & Klingner, 2004). The review of literature supports that students with reading difficulties could benefit from simultaneous instruction in the use of reading comprehension strategies while using text reader software. A question that arises is how to best proceed with reading comprehension instruction using text-readers to accommodate for poor decoding.

Little research has been completed with elementary students. Specifically, in the reading literature, there is a general lack of research involving intermediate participants who use text-reader software as an assistive technology to accommodate for decoding difficulties. Research shows that intermediate students with low reading scores can potentially benefit in the area of comprehension from using text-readers (Disseldorp & Chambers, 2002; Elkind, 1998; Higgins & Raskind, 1997). However, this research is limited in its ability to extend the understanding of how intermediate students perceive the assistive technology. The review of the research has also demonstrated that there is little available that examines the combined use of explicit strategy instruction. This is supported by research as an evidence-based approach to improving students with reading difficulties comprehension strategy knowledge, and the use of text-reader software. The study that is described in this paper will examine the experiences and perceptions of Grade 7 and 8 students identified with reading difficulties while they use assistive technology to enhance their reading comprehension. In addition, the study will explore

the students' combined use of a text-reader (Kurzweil 3000) and the question-answer comprehension strategy. This study has the potential to provide an insight into intermediate students' reactions to using a comprehension question-answer strategy in conjunction with using a text-reader (Kurzweil 3000).

By building on our knowledge of how students with reading difficulties can use assistive technology to improve their reading abilities, we can begin to explore how to instruct these students to become more self-efficient readers who can apply multiple comprehension strategies. This research could also be used to cultivate, pilot, and administer professional development sessions for educators and determine how to integrate text readers into students' programs in a way that will enhance their ability to comprehend and understand text.

Chapter Summary

Researchers and professionals *know* and have documented that many intermediate students with reading difficulties struggle with decoding and that this has an adverse effect on their comprehension abilities. Researchers have also demonstrated that there are evidence-based instructional strategies that enhance students' comprehension of text (NRP, 2000; Snow et al., 1998). However, as students with reading difficulties proceed through the education system and continue to struggle with decoding, they often are not able to learn and use comprehension strategies optimally. There is beginning research suggesting that students with reading difficulties can benefit from the use of a text-reader as an accommodation for poor decoding skills.

Students who are identified as potential users of text-readers will require instruction in using the text-reader software. Instruction on using the text-reader is crucial

to the successful implementation of this accommodation. Research on the combined application of comprehension strategy instruction and text readers will assist in building our knowledge in this new area and can be applied to the development of remedial programs that uses explicit instruction in comprehension strategy application in combination with text-reader software. Text-reader software holds the promise of providing students with reading difficulties with an aid that will foster their higher learning. However, the benefits of using text-reader software are contingent on educators providing students with the necessary support to learn how to use the technology while engaging in strategic processes known to facilitate the comprehension.

Research needs to be conducted on elementary junior and intermediate-grade students to determine whether students will benefit from using text-reader software and how teachers should incorporate text-reader software into their lessons and programs. In addition, investigation into the quantity and nature of training that students will require in order to use the text-reader software is needed. Finally, there is a lack of data addressing whether elementary students gain comprehension skills when provided with assistive technology as an accommodation during instructional lessons. Research on elementary students' comprehension of informative texts while using text-readers is needed to determine whether students benefit from having explicit strategy instruction integrated with text-reader software.

Qualitative studies into intermediate students' use of text-reader software while combined with evidence-based instructional strategies that teach and facilitate students' use of comprehension strategies could provide the foundational data that is needed to design quantitative studies in this area. It would be valuable to the collection of data on

text-reader software to investigate whether students' comprehension improves when using a text reader. This initial data could provide the opportunity for comparison studies involving other students such as those attending elementary schools or those who receive traditional remedial programming. Finally, the findings of this study will add to the growing literature concerning the assistance of students with reading difficulties. Research findings can aid in the development of programs that will assist students with reading difficulties in acquiring academic success and promote higher reading abilities in students who struggle with the acquisition of reading skills.

CHAPTER THREE: METHODOLOGY AND PROCEDURES

In this chapter the reader will be provided with an overview of the methodology that was used in this study. Information regarding the selection of participants, the materials and instruments that were used during the instructional sessions, and how the data was collected and analyzed are also presented. This research used a qualitative case study methodology, with a rationale for this design also being provided in this chapter. The study took place at a research lab and involved three phases, which are described in detail in the Design Overview and the Materials section. The first phase consisted of individual interviews with the participants. The interview process included having participants complete a reading assessment, a think aloud protocol, and an individual interview during one set interview time. A separate interview was also completed with the participants' parents. The second phase consisted of nine instructional sessions. These sessions consisted of a series of lessons that built upon each other to teach participants a reading comprehension strategy while using text-reader software. The third phase consisted of individual exit interviews as well as a focus group discussion with the participants. The final section of this chapter will discuss the limitations and the ethical considerations of the study.

Design Rationale

This study examined the experiences and perceptions of Grade 7 and 8 students identified with reading difficulties as they used assistive technology to enhance their reading comprehension. One of the main interests in this study was exploring participants' experiences while using a comprehension question-answering strategy in conjunction with using text-reader software (Kurzweil 3000). Also, there was a focus on

exploring the participants' preprogram perceptions about reading, comprehension, and assistive technology and monitoring whether their perceptions changed after participating in the program. The instructor's role and experiences in administrating the program was examined as a secondary focus. In the reading literature, there is a general lack of research involving intermediate-grade participants who use text-reader software as an assistive technology. Much of the literature focuses on secondary school and postsecondary students' use of assistive technology. In addition, there is also a general lack of literature exploring intermediate-grade students' perceptions about the use of AT as a reading accommodation. Use of a qualitative case study methodology would facilitate the acquisition of in-depth insights into this relatively unexplored area (Berg, 2004). Specifically, the case study design allowed for the investigation into the phenomenon of assistive technology and to understand how the participants functioned when reading strategy instruction was merged with text-reader software (Fraenkel & Wallen, 2006).

This case study was exploratory in design and instrumental in its purpose (Berg, 2004; Creswell, 2007). This design is especially relevant when researchers wish to examine a new area of research such as how participants with reading difficulties respond to the combined use of text-readers and strategic instruction. Ideally, this case study would have provided additional insights about how text-reader software can be combined with strategic instruction to assist the development of reading comprehension skills of participants who experience reading difficulties.

Design Overview

The participants completed a 6-week course in learning and applying a reading comprehension strategy while using text-reader software. The course consisted of nine instructional sessions (see Appendix A), in addition to two interview sessions and one focus group session. Figure 1 presents a timeline of the overall program (see Figure 1). Prior to the instructional sessions, the researcher met with the participants and their parent/guardians to complete individual interviews. During the interviews, participants took part in a reading assessment in order to gather descriptive data about their reading strengths and areas of need/abilities, establishing a base line for the study. Following this, participants participated in a think aloud activity where their use of strategies during the reading process was explored.

The researcher led the Grade 7 and 8 participants through the nine instructional sessions. The sessions were broken into three types of instruction: modelled, guided, and independent. While the mode of instruction changed across the three session types, the general format of the lessons remained the same. Each session was separated into "before", "during", and "after" reading activities. The before reading activity for each session was used to introduce the text topic and activate participants' prior knowledge. For each before reading component, participants were also introduced to content vocabulary that would be encountered during reading. The during reading activities included reading the text and using the skill of recording thoughts and questions that were stimulated during reading. After reading, the participants utilized question stems to formulate questions for discussion. Each session had an after reading comprehension test that examined the participants' understanding of the text. The use of a consistent format

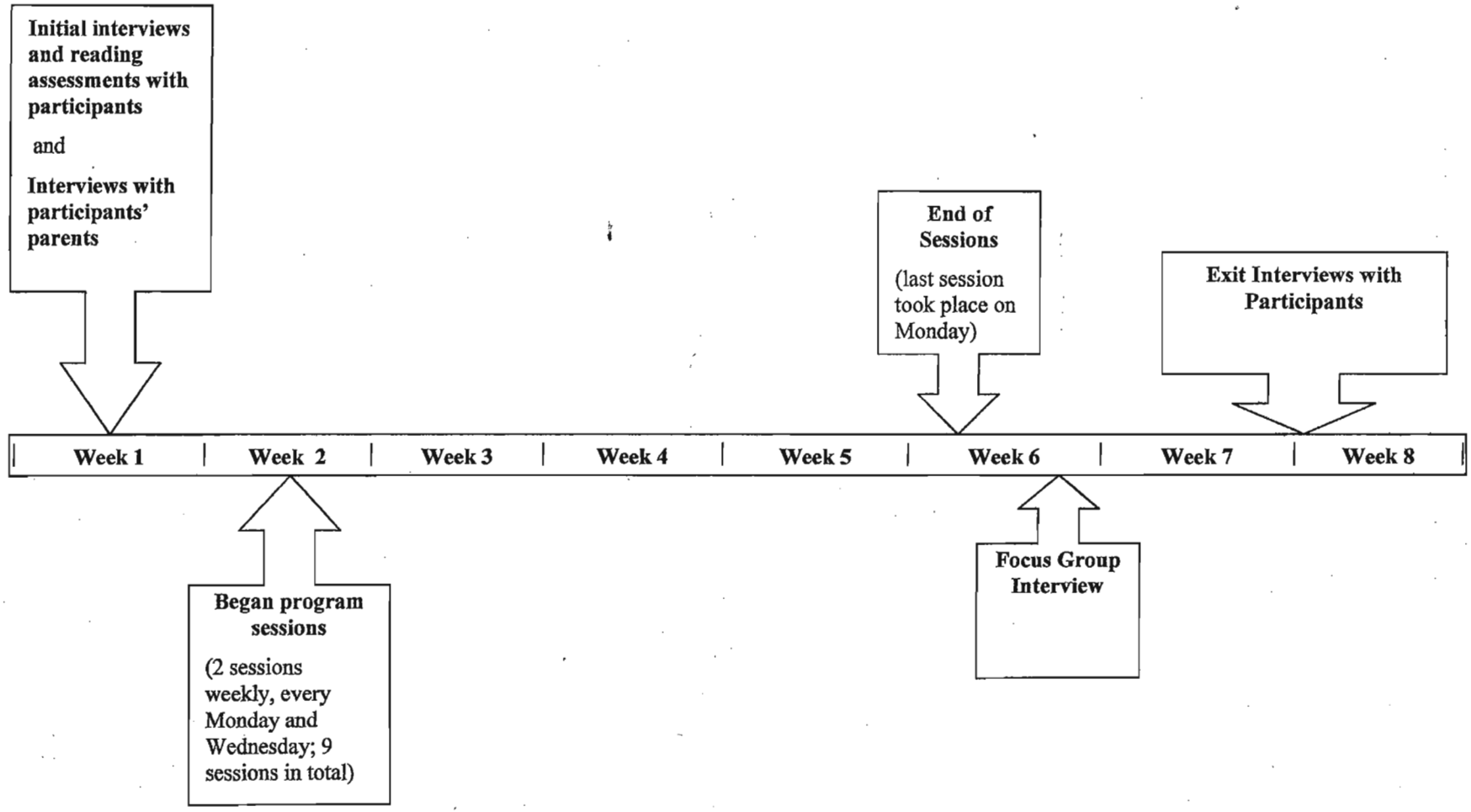

Figure 1. Timeline of program

presumably would reinforce the strategy application as individuals with learning and reading difficulties often need to be provided with repetitive strategy instruction in order to gain proficiency of its use (Foorman & Torgesen, 2001; Simmons & Kame'enui,1998).

In the first three sessions, the application of the question-answering strategy was modelled for the participants. Specifically, the think aloud process was combined with modelling to demonstrate the use of the strategy while reading science text. As part of this process, the researcher also demonstrated how students can activate relevant prior knowledge before engaging in reading. The activation of prior knowledge was completed through a "K-W-L" chart (see Appendix B) that would allow participants to record their knowledge in an organized manner (Ogle, 1987). As part of the modelling process, the participants were also provided with metacognitive information about the question-answering strategy including "why" "when" and "how" this strategy should be used. A print copy of the text was used during the first session; with digital copies of the text (Kurzweil 3000 document format) used in all subsequent sessions. A digital copy of the text is very similar to a print copy, as it remains in the same format on the computer screen as it appears in print copy. However, the digital copy has been scanned into the computer, appears on the computer screen, where the text-reader software can recognize and read the text to the students.

In the second set of three sessions, the participants took part in a guided application of the question-answering strategy in combination with the text-reader software. These guided application sessions were designed to prepare participants to use the strategy and text reader software independently. The researcher led the participants into gradually applying the strategy components independently. This process allowed for

detailed observations of the participants' progress of understanding and applying the strategy to the text. The observation of participants during these scaffolded instructional sessions also allowed for any necessary readjustments to future lessons. For instance, it was necessary to reinforce the strategy application process when participants demonstrated weak understanding of the strategy concepts.

In the third and final set of three sessions, participants were encouraged to use the question answering strategy and text-reader software independently. Specifically, the participants used the question strategy while the researcher facilitated their use of the text-reader and the comprehension strategy. At the beginning of each of these final sessions, the question-answer strategy was reviewed with the participants. The participants were fully involved in these reviews and the researcher facilitated the review by engaging them in recalling strategy steps and procedures for the purpose of review as well as reinforcement of the strategy steps.

The third phase of the research process consisted of postinstruction individual interviews as well as a focus group discussion. The individual exit interviews were similar to the initial interviews. Many of the same interview prompts and questions were reviewed in order to gain insights into any changes in participants' thoughts and beliefs after completing the nine instructional sessions. However, where initial interview questions were more general in nature, the exit interview questions were more specific in addressing the text-reader software used and the application of the question-answer strategy.

Participants

Students who possess a repertoire of effective reading strategies are likely to be successful learners (NRP, 2000). Unfortunately, the acquisition of such strategies can be challenging, especially for older students who experience reading difficulties. The primary grades are the most effective time for remedial programming and intervention (NRP; Ruddell & Unrau, 2004). Students who enter the junior and intermediate grades without such programming are especially at risk for continued reading difficulties and, thus, are of primary interest in this study (Gunning, 2002; Jenkins et al., 2000).

The participants in this study were from the elementary intermediate division, specifically, Grade 7 and Grade 8. The recruitment of 4 to 8 participants was the ideal number for the program as it allowed for small group and partner activities as well as group interaction. This number of participants also allowed for the researcher to be highly involved in the instructional process and in the monitoring of each participant's experiences during the program. The program enlisted five students at the beginning; however, due to prior commitments to sporting activities, one of the participants had to drop out. This participant's information is not included as part of the study due to incomplete data collection. Participants all resided within Ontario and attended elementary schools that followed the Ontario school curriculum. All participants have been identified as having a reading difficulty by a parent, educational assessments, and/or a teacher and have been identified as individuals who would benefit from the provision of assistive technology (i.e., text reader). Three out of the 4 participants have an Individual Education Plan (IEP) that recommends the use of assistive technology to improve academic performance and accommodate for reading and writing difficulties. The

program was presented to many parents through oral presentations and fliers. Fliers were provided to schools to deliver to parents whom teachers believed may have been interested in the program. A presentation was also delivered to parents of children with learning difficulties at a learning disabilities support group meeting to inform them of the opportunity to have their children participate in this study. Parents were provided with information regarding the types of students who may benefit from text-reader software and the program. Through discussions between the researcher, parents, and their children, it was determined whether this program would have been appropriate based on the information provided by the parents. The information included the reading abilities and skills of the potential participants, current educational programming they were receiving, and other factors such as the potential participants' interest in technology, interest in science, and need for comprehension instruction. Altogether, there were two Grade 8 participants and two Grade 7 participants.

Instructional Materials

The instructional materials consisted of texts, tests, and worksheets that participants would use throughout the program. Also, detailed descriptions of the text-reader software and the question stems are provided in this section. Also included in this section are the descriptions of the lesson plans which provide detailed outlines of the session procedures and the role that the instructor plays during the sessions.

Kurzweil 3000 Software

Kurzweil 3000 (Kurzweil Educational Systems, 2002) is a text- reader software program. Text-reader software can be used to provide intermediate-grade participants with decoding support (Hitchcock, 2001; Ontario Ministry of Education, 2005). The

software provides students with the opportunity to apply reading comprehension strategies while listening to text, a task that can be difficult to achieve for students who struggle with decoding. Kurzweil 3000 contains many features, including synchronized visual and auditory presentation of the text, adjustable reading speed, and male or female reading voices. In addition, the software includes reading tools that can aid the user in using reading strategies while engaging with the text. Of particular relevance here is the sticky notes tool. In the context of this study, the sticky notes tool provided participants with a digital notepad to record their thoughts and questions while processing text. This tool is equivalent to using sticky notes when reading text in hard copy print form. As part of the second instructional session, participants were introduced to the Kurzweil program and had the opportunity to select their preferred voice tone and reading speed. They were also encouraged to explore the sticky note tool and the rest of the features of the program.

Generic Question Stems

Question stems (see Appendix C) were used to assist participants in creating questions. These questions were used to guide participants' discussions about the texts they read during the sessions. The stems were used to guide students in the creation of two categories of questions; memory questions and thinking questions. Memory questions required the participants to recall the answer directly from the text while thinking questions required the participants to predict, infer, or use prior knowledge to create an answer. Participants were provided with a copy of the question stems on laminated cards with each question stem providing a basic outline for a question (King, 1992). For example, the stem, "How are …and …similar?" could be used to generate the question, "How are detectives and crime scene investigators similar?" The versatile

nature of the question stems allowed the participants to apply them across all the instructional sessions. The researcher demonstrated how to generate questions using the question stems during the first set of sessions and reinforced the use of question stems throughout all subsequent lessons.

Text Readings

The reading materials consisted of science content readings that ranged between the Grade 7.0 to 8.9 reading levels. This range in reading levels for the texts was determined by establishing that participants would read grade-level text as they were provided with text-reader software to accommodate for decoding difficulties. As the participants were all in Grade 7 or 8, these levels for the readings were deemed appropriate. All readings were scanned into the Kurzweil 3000 text-reader to accommodate for students' decoding difficulties. The readings were based on science content that is not explicitly part of the Ontario Science curriculum. These materials were selected purposely to avoid overlap between the materials used in the participants' classrooms. Science was selected as it allowed for the use of non-fiction text and provided the opportunity to select readings that were considered to be of high interest to students at the intermediate-grade level. The readings that were used during the sessions are compatible with the question-generation stems that were used throughout the instructional sessions. The question stems that were used are generic and can be applied to numerous types of materials. King's (1992) question stems are based on the higher levels of Bloom's (1956) taxonomy of thinking and provided participants with a question design that prompted them to apply critical thinking on the materials provided. The stems provided participants with the opportunity to apply, analyze, evaluate, and elaborate on

the provided texts. King (1990) found that students who were provided with question stems formed more thought-provoking questions. These questions lead to more elaborate explanations as they require students to think critically about the main ideas within the topic and require students to perform higher-order thinking skills such as comparing and contrasting elements and answering why questions. King (1990; 1995) found that students who used question stems before, during, and after reading a text performed higher in a comprehension test than students who did not. Similar to King's results, Gunn (2008) found that use of question stems increased students' abilities to recall and apply information from text. Question stems can be applied to a variety of readings and the question stems that the participants used were selected as they were believed to facilitate the generation of critical-thinking questions using informational text as the base. The readings were non-fiction science texts based on three topics and, therefore, qualified informational texts.

The level of the selected texts was established by using the Flesch-Kincaid Reading Level software that is built into the newer versions of Microsoft® Word (Flesch, 1948; Kincaid, Fishburne, Rogers, & Chissom, 1975; Microsoft, 2003). The core science vocabulary from each text was excluded from the readability measures as the repetition of the large science-based words artificially increased the reading level of the text. However, these vocabulary words were not removed from the texts. The science vocabulary included words such as *investigation* (Session 1 – 3), *atmosphere* (Session 4 – 6), and *chemical* (Session 7 – 9). These science vocabulary words were taught to the participants before the reading of texts took place. The readability levels for each instructional text fell between the Grade 7.0 to 8.9 reading levels without the science

vocabulary included. The readings varied in length, ranging from 3 to 7 pages. Most of the readings included pictures and/or diagrams along with the text.

The readings for the first three sessions were based on the topic of crime scene investigation (CSI). The first reading, *How crime scene investigation works: Part one* (Layton, 2005) was the first part of an article written by Julia Layton. The other two parts (part two and part three) were used for sessions two and three, respectively. In Part One, the nature of a CSI was described as well as who was involved in one. Part Two described the chronological steps taken in a CSI. Part Three described the evidence collection in more detail.

The readings for the second set of three sessions addressed Environmental science. Here, participants were examining the concepts of global warming and climate change. The first reading of this set was entitled, *An introduction to global warming and climate change* (Woodford, 2006). This reading described the nature of global warming and climate change and their effects on the world. The reading also described the reasons behind the global warming and climate change. The reading for session five was entitled, *The impact of global warming and climate change* (Woodford). In this reading, the author examined the impact that climate change is having on our world, specifically in Ontario, and how this affects humans. The reading for session six, *Recycling* (Bosak, 2000), described methods of reducing pollution and recycling, including suggestions about how individuals can reduce their contribution to climate change. It included instructions on how to recycle old newspaper and vegetable peelings.

The readings for the third set of sessions reviewed inventions. The readings built the participants' basic knowledge of inventions by exploring how inventions are created

and through real stories about people who have become inventors. These readings described how science can be applied to various areas in our lives and in others' lives. The reading for session seven, *About inventing* (Riley, 2003), was a non-fiction piece written by an inventor about the process of becoming an inventor. Session eight's reading consisted of two stories of how inventions can make life easier, both on a small scale (i.e., providing small comforts to one person in the morning) in an article by Fox (2003) and on a large scale (i.e., formulating a device to make water more accessible to children and families in Africa) in an article by Fox (2005). The final reading, *Funny rubber*, was a short, non-fiction recollection which described how James Wright, a chemist, created a mixture that eventually became known as Silly Putty (Haven, 1994).

Classroom Strategy Prompts

To prompt participants' use of the applying strategies while reading the texts, instructional charts were placed around the room where participants received the instructional sessions (see Appendix D for the general chart outline). These charts were similar to the chart that was created with the participants during the first instructional session. Specifically, the chart contained an outline of how participants could carry out the question-answering strategy while using the text-reader. Participants following this chart would (1) review what they already knew about the topic; (2) generate questions based on what they want to know or wonder about the topic; (3) read the text in chunks and record any thoughts on sticky notes; (4) generate questions on topic; (5) answer questions on topic; and (6) record what they have learned. The charts also acted as prompts to participants to encourage the use of K-W-L charts and the use of questions stems.

Instructional Sessions

The nine instructional sessions followed three sets of lesson plans (see Appendix A for outline of lessons). A specific objective was associated with each lesson set: the objective of the first set of lessons was to understand and observe the strategy being used; the objective for the second set of lessons was to guide and assist the participants in using the strategy; and the objective for the third set of lessons was to facilitate the participants' independent use of the question strategy. Each session followed a similar format with participants engaging in before, during, and after reading activities.

Specifically, each 90-minute session began with a whole-group introduction to the day's topic. Participants used a K-W-L chart (Ogle, 1987) to activate and record their prior knowledge about the topic and to address any questions that they may have had about the topic before they began reading. Participants also reviewed the question generation strategy steps and reviewed how question stems can be used to develop questions. They also discussed the parameters associated with strategy use ("when" and "why" they should use the strategy). During the use of the Kurzweil 3000 text reader, participants used the "sticky notes" tool to write down any questions or thoughts that occurred while reading. After reading, the participants created questions using the question stems. Participants examined the questions created, decided whether they were memory questions or thinking questions, and answered the questions accordingly. After participants had completed the question-generation strategy, they reflected on what they had learned and recorded this information in the final section of the K-W-L chart. Finally, the participants completed a comprehension test for each reading (see Appendix E for an example of a comprehension test).

Sessions 1- 3: Modelled Strategy Application

The first three of the nine instructional sessions were taught using a modelled teaching approach. This involved think alouds and metacognitive discussions about the parameters associated with the question-answering strategy. These included why the question-answering strategy is useful, why it should be used in certain situations, and what the participants could learn from it. Each session followed the same format: activating prior knowledge before reading; reading text and tracking thinking using sticky notes; then formulating questions and answers after reading. This format and the strategy were modeled by the researcher for the participants during the first three lessons. Specifically, the researcher modeled how the strategy could be used effectively, thinking aloud as the text was processed. During the first session, the Kurzweil 3000 text reader was not used to read the text. Instead, the text was read aloud by the researcher. This format was followed so that the participants could become familiar and comfortable with the question-answering strategy first, focusing only on understanding the strategy's steps before being introduced to the text reader software. For all subsequent sessions, however, the text-reader software was used to assist participants in the decoding of the text.

During the first session, the question strategy was modelled for the participants. The first step was introducing the participants to the question strategy. This was done to assist them in learning and understanding why this strategy could be helpful in comprehending reading materials. Participants were asked to participate in a brainstorming activity that explored how generating questions could help individuals to comprehend information. Providing a rationale or reason for using a strategy increases the likelihood that participants would continue to use the strategy beyond the

instructional setting (Alexander, 2004; Nelson & Manset-Williamson, 2006; Palinscar & Brown, 1984). After discussing how generating questions could assist in the learning process, the researcher then demonstrated the activation of relevant prior knowledge. Specifically, the participants received modelled instruction on how to record prior knowledge on the *know* section of the K-W-L chart. Following this, the researcher demonstrated, through a think aloud, how prior knowledge could be used to create 'I wonder' questions and how to fill in the *wonder* section of the K-W-L chart. The researcher then modeled the thinking processes while reading. This process involved posing questions as well as stating thoughts and reactions to the text and recoding them on post-it notes. The participants also received explicit, modelled instruction for the after-reading activity, which involved creating questions about the text using the question stems. After the questions were created, the thinking process that was used to answer the questions was modelled for the participants, qualifying whether the reader needed to look in the text, infer answers from what was read, or find the answer through further research. This modeling led into a discussion about question types. The generated questions were sorted into two types: memory questions (answers found in text), and thinking questions (answers found outside of text, including inference and prompting questions). After this process was completed, the participants than received modeled instruction on how questions that had been created could be used to complete the K-W-L summary chart. The final step of the lesson involved modeling how to answer the comprehension questions for the passage. After the instructional section of this session was completed, the group created a chart that outlined the steps of the question-answering strategy.

During lessons two and three, the participants were encouraged and prompted to participate in the modelled sessions and think aloud procedures so they could be scaffolded to demonstrate their acquired knowledge and application of the strategy. Participants were called upon to recount why the question-answering strategy is used and what knowledge one could gain from using it. This allowed the participants to develop their metacognitive understanding about why they should use this strategy, which could lead to a more productive use of it (Boulware-Gooden, Carreker, Thornhill, & Joshi, 2007; Pressley & Afflerbach, 1995).

Sessions 4-6: Guided Strategy Application

Sessions four to six followed the same format as outlined in the first set of sessions. However, the teaching approach changed from modelled instruction to guided instruction, allowing the researcher to provide the learners with scaffolded instruction so participants would be more inclined/likely to use the question-answering strategy independently. During these three sessions, control was gradually released over to the participants by having them complete the lesson in small groups of two or three, until they demonstrated that they were capable of performing most tasks independently, which would take place in the next set of sessions. Presumably, the guided sessions would allow for a steady transition from observing the strategy modelled into using it independently (Alexander, Graham, & Harris, 1998; Sinatra, Brown, & Reynolds, 2002). This process was critical for their learning of the strategy as it provided the researcher with the opportunity to assist the participants in perfecting their application of it. The participants worked together in groups of two or three and created questions. They read the text on

their own using the Kurzweil 3000 to alleviate decoding difficulties. Participants also used the sticky note tool to record their own notes while reading.

Sessions 7-9: Independent Strategy Application

In the final three instructional sessions, participants were encouraged to create and answer questions independently. That is, by the final session, it was expected that each participant could complete the question-answering lesson format without assistance from the instructor. Briefly, the group reviewed the question-answering strategy at the beginning of each session with the participants. Participants would then complete the first two sections of the K-W-L chart to activate their prior knowledge, sharing their thoughts with a partner. Participants used the Kurzweil text-reader to read each text selection independently. During reading, participants used the sticky note tool to record any questions or thoughts that occur while reading. After reading, participants used the question stems to generate their own questions. Participants also identified whether a question was a memory question or a thinking question. Group discussions, led by participants, were held after the question generation process to review and discuss the questions created. Finally, at the end of each session, participants completed a comprehension test.

Data Collection Materials

This section includes descriptions of the materials used before, during, and after the program's completion to collect data. These materials include interviews, think aloud materials, focus group questions, session activities, and researcher field notes.

Individual Interviews and Reading Assessments

Individual interviews were completed with the participants and their parents. Interviews (see Appendix F and G) were conducted at the beginning and end of the program. In addition, during the initial interview, a reading assessment was conducted with each participant (e.g., *Gray Oral Reading Test*, Wiederholt & Bryant, 2001; *Stanford Achievement Test: Listening Comprehension*, Stanford Achievement Test, 1995) as well as a think aloud protocol. The reading assessment allowed for the gathering of descriptive information about the participants and their reading abilities. The descriptive information included independent reading levels, reading comprehension levels, and an informal text of reading strategy use. Also included in the collection of descriptive data were the participants' listening comprehension levels. The collection of this information allowed for a more comprehensive view of the participant as a reader, highlighting their strengths and difficulties in the areas of decoding and reading and listening comprehension.

The purpose of the interviews was to explore participants' perspectives about the reading process, effective reading strategies, and the role/value of text-reader software. The participants were asked about their familiarity with technological devices including assistive technology. In the initial interview, participants were asked about their prior use and knowledge of text-readers, including the Kurzweil 3000 software. In the exit interview, participants were asked about their views on assistive technology, their perceptions on text-readers, and their perspective on the value and use of text readers in school and at home. Participants were asked similar questions during the exit interview so their responses could be compared and evaluated to their answers from the initial

interview. Of special interest was the exploration of any changes in participants' perception about the value of using the question-answering strategy and assistive technology.

The participants' parents were also interviewed at the beginning of the program to explore their perspectives about the reading process, participants' reading strengths and areas of need, and the role of assistive technology in the reading process (see Appendix H). This added to the data regarding students' experiences with reading and reading instruction and provided more in-depth views into the participants as readers. The more that is known about these participants and their reading behaviours, the more we can explore how using a text reader impacts them as a reader.

Think Aloud

The think aloud is a verbal procedure where participants were encouraged to verbalize their thought processes while reading (Afflerbach, 2000; Smith, 2006). The think aloud protocol enabled the researcher to hear students' metacognitive thinking processes as well as assess their comprehension of text. In this study, participants completed a think aloud during the initial interview. The passage was a non-fiction science text (Fox, 2007). It was based on a different science topic than the topics of the instructional session readings. The passage was a Grade 7 reading level text. Participants were asked to verbalize what they were thinking as they read, and were asked to describe any strategies that they used while reading. When necessary, participants were provided with prompts while reading. Brower, Raphael, and Missimer (2000) suggest prompting participants with questions such as "What are you thinking/doing now?" and "Describe the steps that you are going through here." Participants' think alouds were audio

recorded. The tapes were transcribed and analysed for participants' use of strategic reading processes.

Focus Group Interviews

At the end of the instructional sessions, a focus group session was held with the participants. The focus group was facilitated by the researcher and held in the same facility where the sessions took place. The purpose of this session was to provide participants with the opportunity to share and discuss their perspectives about using the text reader and question-answering strategy. A focus group was utilized in this study as it allowed for participants to discuss the technology with same-aged peers. It provided participants with a unique opportunity to hear opinions of other intermediate-grade students who use AT to accommodate for reading difficulties. The question prompts were open-ended, and included such questions as "How can the Kurzweil 3000 text-reader assist a student in reading? and "Would you use the Kurzweil in at school or at home? Why or why not?" (see Appendix I). The focus group session was audio and video recorded and lasted for approximately 40 minutes.

Instructor's Field Notes

The instructor's field notes were a recollection of the lessons and the participants' reactions, interactions, and comments during each session. Included in the field notes are personal reflections of the researcher about leading the instructional sessions and interactions with the participants. Notes were written after each session, although quick "jot" notes were written during the program as issues arose. The field notes also assisted in monitoring participants' progress throughout the sessions and making any adjustments

to the planned lesson such as needing to review and demonstrate how to use the question stems.

Session Activities

The questions that participants generated were collected at the end of each session. These are part of the data collected from each session. The sessions were video recorded in order to allow for transcribing of the conversations that took place during the sessions. This was in addition to the data recorded from their discussions surrounding the questions, including the question-answering section of each session. The audio recordings from these sessions were transcribed and coded, then analyzed along with the questions that were generated.

Participants' responses to the comprehension tests associated with each text reading were also reviewed. These tests included five questions about the text that required students to answer literal, inferential, and critical thinking questions about the text. The test questions utilized both memory questions and thinking questions. While some of the questions related to the question stems, none of the questions used the exact question stem format. The comprehension tests followed a traditional test format, which expected participants to be able to answer an array of question types. The questions on the test varied in form; multiple choice questions, short answer questions, and definition questions were used. A variety of question types helped avoid overlap between the potential questions created by the participants and the test questions. Participants were allowed to respond verbally to the comprehension questions, so that their learning was not underestimated due to any writing difficulties. Participants' recorded answers were transcribed, coded, and evaluated according to an answer sheet. Comprehension tests

were marked out of 10 to 16 marks and short-answer questions were worth more marks than a multiple choice question. Another educator evaluated copies of participants' comprehension tests in order to provide a higher level of reliability in the marking process.

Data Analysis

Analysis of qualitative data (e.g., interview transcripts, think-alouds, field notes, lesson plans) consisted of coding and categorizing as described by Bogdan and Biklen (1998) and Creswell (2002). The initial interviews with the participants and their parents, along with the exit interviews, were recorded using audio recordings. The tapes of the interviews were transcribed after they were completed. In addition, the researcher's field notes were analyzed for emergent themes. The data were coded by theme and were combined with participant data to create the case studies. The data were coded by identifying sections of the transcriptions, videos, and field notes that reflected a certain theme, with some sections being identified for multiple themes. For example, during the focus group session when participants discussed their experiences using questions, participants also began discussing their experiences using the text-reader software to assist them in creating questions. This instance documents a time where data were consistent with two themes: 1) participants' proficiency in strategy use and 2) the integration of strategy use and text-reader software. Six themes emerged in total. Some of which were expected to occur, such as the themes that examined participants' use of strategy and the integration of using a text-reader while using a reading comprehension strategy. Other themes, such as the, "socialization of learning", initially were not anticipated (albeit not surprising in hindsight).

The think-alouds were also transcribed. After the transcribing, the tapes were analyzed for the reading comprehension strategies that were exemplified. Scoring of the think-alouds included an examination of the strategies and techniques that participants used while reading, including activating prior knowledge, setting a purpose or goal for reading, making connections to text (personal, text-to-text, text-to-world), making predictions, visualization, asking questions, and monitoring and summarizing their understanding. These data were used as descriptive information, along with the other reading assessments (i.e., GORT; SAT).

Also included in the data analysis were the participants' responses on the daily comprehension tests, which were scored using an answer sheet. An unmarked copy of each test was provided to another qualified teacher in order to provide an inter-rater check on the grading. After grading the participants' comprehension tests independently, students' comprehension tests were compared to determine for grading consistency. Overall, inter-rater agreement was high, with 100 percent agreement. If disagreements had been present, they would have been resolved through discussion using the answer sheet as a guide.

Quantitative measures of participants' reading performance were used as descriptive data. The results of the reading assessments were used to describe participants' reading strengths and areas of need. For example, a participant may have been strong in her knowledge and use of some reading comprehension strategies, such as mental imagery and making connections, while her decoding abilities were assessed to be at a Grade-4 level. Collectively, these measures were used to describe the participants' overall reading comprehension, fluency level, decoding, and listening comprehension

abilities in comparison to the standard levels provided for the average intermediate grade reader.

After all data had been transcribed, analyzed, and arranged into case studies, member checks were completed with the participants. As part of this process, participants were provided with a copy of their written narrative case study as well as any conclusions based on them.

Methodological Assumptions and Research Limitations

When working with qualitative methodology, it is an intrinsic limitation that generalizations to the larger population cannot be made (Berg, 2004). Although there was more than one participant within this case study, it is not plausible to generalize outside the intermediate participants included in this study. While this research may lead to suggestions for further inquiry that could be generalized to the larger population of participants with reading difficulties, this research remains exploratory and allows for further growth and understanding about students' experiences using assistive technology and the question-answering strategy.

The students who were invited to participate in the study either had been identified as having a reading difficulty by their parents, teachers, or other professional organizations. While each of the participants had a reading difficulty, each participant's difficulty was composed of a unique set of characteristics, based on that participant's strengths and weaknesses as a learner and a reader. This is a limitation that could affect the level of learning to apply the reading comprehension strategy. The teaching strategies that were used (modelled and guided teaching styles), have been found to be effective in teaching participants of all levels and abilities (Block et al., 2002; Dole, 2000; Duffy,

2002). While participants varied in their learning pace, the program was designed so that participants would have a significant amount of time to view and practice the strategy application before having to apply the strategy independently. The participants were consistently monitored and the lessons were designed to allow for flexibility in reviewing the steps of the strategy if participants were struggling with any concepts.

Additional limitations affecting the dependability and trustworthiness of this study involved the materials being used. While the materials were selected to appeal to participants' interests, some topics may have been of greater interest to some participants than others resulting in these participants being more motivated and more engaged in the instructional sessions than their peers. In an attempt to circumvent this possibility, the instructional topics selected were ones believed to be relevant to students' everyday lives. For instance, many students have viewed CSI on television and in movies. Similarly, environmental issues have become common knowledge with all Canadians being urged to adopt environmentally-friendly behaviours. Finally, the last sessions' selections of readings were based on scientific inventions over the past 60 years. Participants had all had experiences with the inventions of our society and this subject expanded on their knowledge of how inventions materialized and became part of our everyday lives.

Another limitation with the material was the vocabulary found within each text. Many of the words were science-based words and, therefore, may have been unfamiliar to the participants. In order to accommodate for this limitation, the vocabulary of the text was reviewed before beginning each lesson.

One final limitation with the material was the readability level of the text. Most of the participants have been receiving accommodations at school that lower the level of

their reading material in order to accommodate for their reading difficulties. Participants may have found the reading material more difficult as they may be used to reading lower level text, even though participants were not required to decode the text. This may have impacted their ability to comprehend the material due to the higher reading level and more extensive vocabulary. Using the Kurzweil text reader accommodated for any decoding difficulties and the researcher was there to monitor participants' ability to apply the comprehension strategy to the text. The instructional lessons had been created to be flexible and allow for the reiteration of either instruction in the use of the question-answering strategy or text reader software. During the initial interview, participants were provided with reading comprehension and listening comprehension tests to determine their comprehension ability in both areas. A potential limitation involved participants scoring higher on the reading comprehension measures than on the listening comprehension ones. Fortunately, this did not occur within this study. However, had this occurred, the Kurzweil provided participants with simultaneous visual and audio versions of the text, which provided participants with the text to follow along with as the Kurzweil read the text aloud.

A major limitation within this study was the students' difficulties with writing. Many students with reading difficulties tend to have difficulty writing as well (Lerner, 2003; Winzer, 2007). Although, the comprehension tests that were administered at the end of each instructional session were designed so that students could answer the questions in print format, the comprehension test was read over the Kurzweil (to alleviate the reading difficulties) and the participants were provided numerous options to record their responses to the questions. If they wanted to write out their own responses, they had

the option of writing out their answers free-hand on a print copy or they could record their responses in the Kurzweil program. If they found writing to be difficult, they were provided with two options. The first option was that they could say their responses into an audio recording device that would later be transcribed by the researcher. The second option was to have the researcher act as a transcriber and scribe the participant's responses from an oral discussion. Consequentially, participants may have provided more elaborate answers while using a tape recorder or having the researcher scribe their answers than if they were required to write their answers.

Further limitations involved the researcher's bias towards the outcome of this study in that it was expected that a growth in participants' abilities to use the question answering strategy and text reader software and overall comprehension abilities would occur. Involving another qualified teacher to evaluate participants' performances helped circumvent this bias. Member checks were also a part of the data analysis to ensure that what the participants said were not taken out of context and were recorded and interpreted correctly.

Establishing Credibility

Data triangulation assisted in strengthening the dependability and trustworthiness of the data that was collected (Berg, 2004; Creswell, 2005). In addition, the instructional sessions and corresponding comprehension tests were examined and edited by two experienced elementary teachers prior to the implementation of the program. These individuals provided feedback with respect to the text reading levels and content matter, as well as feedback on the corresponding comprehension tests and their ability to measure participants' understanding of the text materials. The instructional sessions were

also reviewed by the same experienced educators for their instructional appropriateness. This process of evaluation helped improve the quality of the sessions and the comprehension tests as feedback from the teachers was incorporated into the tests to create a more effective tool to measure comprehension.

Data triangulation was achieved in this study by collecting multiple sources of data. The initial and exit interviews, in conjunction with the think-aloud protocol, were multiple sources of data for this study. A second set of sources of data were the instructional sessions, consisting of the comprehension tests, participants' lesson activities, and the researcher's field notes. The researcher transcribed the data and asked parents and participants to review and verify the narratives created from the transcripts. The member-check also increased the credibility of the study and the findings generated.

Ethical Considerations

This study was given clearance by the Brock University Research and Ethics Committee (see Appendix J). Once this study had been approved by the Ethics Committee, the participants were contacted. Informed consent was gained from both the participants and their parent(s) because the participants were under the age of 18. At the beginning of each interview, consent and assent forms were read over with the participants and their parents, describing the research process, and explaining how the findings would be disseminated

Chapter Summary

The purpose of this study was to examine the experiences and perceptions of Grade 7 and 8 students identified with reading difficulties while they use assistive technology to enhance their reading comprehension. In addition, the study will explore

the students' combined use of a text-reader (Kurzweil 3000) and the question-answer comprehension strategy.. The intent of this study was to gather qualitative data regarding the participants' comprehension of grade level text that has been decoded for them by text-reader software. A qualitative case study design was created to gather an in-depth perspective of the participants and the experiences that they have learning a question-answer comprehension strategy. A three-phase research plan allowed for the collection of a variety of data. The first phase consisted of the initial participant and parent interviews, along with reading assessments for the collection of descriptive information about the participants' reading abilities. The second phase involved the implementation of the nine instructional sessions. Three consecutive methods of teaching approaches were used, each one building on the participants' skills and knowledge base of the strategy use with the Kurzweil 3000 text-reader. The final phase consisted of a focus group and individual exit interviews with the participants. Data were then transcribed, analyzed, and coded for emerging themes.

CHAPTER FOUR: PRESENTATION OF RESULTS

In this chapter the analysis of the transcribed interviews, lessons, and discussions is presented. The data presentation consists of case studies of participants and the themes that emerged from data analysis. First, the participants are introduced as single cases, identifying their individual reading abilities, experiences, and beliefs in order to provide an extensive overview of the participants as individuals. Emerging themes are then presented where data, collected from the participants and the researcher, are combined to form independent themes. Finally, a summary highlights the major findings of each theme.

Data Analysis

In order to make meaning and develop connections between the transcripts, field notes, comprehension tests, and videos, these data were analyzed for emerging themes. A preliminary exploratory analysis was conducted by the researcher to assist in organizing and developing an understanding of the potential emerging themes (Creswell, 2005). The data were then coded to reflect potential and developing themes (Creswell). The themes that emerged through the analysis were (a) technology as an instructional hook, (b) proficiency of participants' strategy use, (c) integration of technology and question-answer strategy, (d) changing role of instructor, (e) social interactions among participants, and (f) technology as a platform for differentiated instruction.

The themes connect with the research questions that guided this study. The themes of "proficiency of participants' strategy use", "integration of technology and question-answer strategy", as well as the theme of the "changing role of the instructor" all form a multivaried response to the primary research question: "What are the reading

experiences of Grades 7-8 students with reading difficulties while using the question-answering strategy and text-reader software?" The themes of "technology as an instructional hook", "social interactions among participants", and "technology as a platform for differentiated instruction" provided insights related to the secondary research question: "What are Grade 7-8 students' with reading difficulties preprogram beliefs about reading, reading comprehension, and assistive technologies? Do these beliefs change as a function of participating in the Science and Reading program and learning to use a reading comprehension strategy in conjunction with Kurzweil 3000?"

Participant Profiles

Each participant is presented as a single case. Participants' identities are confidential and, therefore, each participant is identified by a pseudonym. Descriptions of the participants, their reading experience and abilities, their experience with assistive technology, as well as parental interview data are included as part of the participants' profiles. Participants completed a series of reading assessments measures, interviews, program sessions, a focus group, and comprehension tests. The participants' performance scores for the preprogram reading assessments, the Gray Oral Reading Test (Wiederholt & Bryant, 2001) and the Stanford Achievement Test (Stanford Achievement Test, 1995), are presented in Table 1 and Table 2.

Connor

Connor is a 14-year-old, Grade 8 student. He has been diagnosed with multiple disorders that have had a great impact on his learning experiences. He has been diagnosed with Tourette's Syndrome (TS), Obsessive Compulsive Disorder (OCD), Attention Deficit Hyperactivity Disorder (ADHD), as well as a Learning Disability (LD).

Table 1

Descriptive Information about Participants' Reading Abilities Derived from the Gray Oral Reading Test

Participant	**Fluency Score**			**Comprehension Score**		
	Percentile	Age Equivalent	Grade Equivalent	Percentile	Age Equivalent	Grade Equivalent
Connor	50	14.9	9.7	16	11.0	6.0
Ally	9	10.9	5.7	9	9.3	4.2
Brianna	16	11.0	6.0	5	8.9	3.7
Devin	25	11.3	6.2	50	12.9	7.7

Table 2

Descriptive Information about Participants' Reading Abilities Derived from the Stanford Achievement Test

Participant	Percentile	Grade Equivalent
Connor	43 (average)	7.6
Ally	21(below average)	5.1
Brianna	25 (low average)	5.9
Devin	56 (average)	8.9

He is a strong advocate for himself as well as other students with exceptionalities and readily shared his experiences with the researcher as well as with the other participants in the group. He is an outgoing and friendly teenager who appeared to be comfortable participating in the program and associated interviews. Connor is integrated fully in a regular class with accommodations provided as stated in his Individualized Education Plan (IEP). Connor is withdrawn from class when he requires extra support and may leave the classroom when he needs to "escape" or find a "calm place." While Connor has several accommodations listed as part of his IEP, including the use of assistive technology, Connor and his mother both reported that he does not receive as much assistance as when he was younger. Connor also does not use assistive technology, although he was trained briefly on a speech-to-text program in Grade 7. Connor indicated he enjoyed using the assistive technology and would have liked to have it continued as an accommodation.

> I was actually pretty, like, ... how do I explain this? I was pretty excited to be using it because after I had gotten used to it, it was pretty fun. (Connor, Interview #1)

Connor's mother reported that the school year held many changes for Connor. His grades and attitude improved and his confidence increased. Connor's mother believed this change was the result of her requirement that he put greater "effort into school" and her tutoring efforts. She explained that she begins her tutoring sessions at Connor's instructional level and then breaks down the steps for him so he can learn to complete the assignment.

> [A]bout a year or 2 ago, he was completely failing. They were going to hold him back. He had 45% in math. So I said to him "Well, you have to have a tutor. It's either me or somebody else" and he said he wanted me to tutor him. I said, "Well, these are the rules", you can't get angry, you know, we went through the expectations and then pretty much started to work. This year he's had homework everyday, well not now, but in the beginning of the year, homework everyday in math and really worked on it at home. He received a 92% in one of his classes. And with reading, with doing the book reports the way we've being doing them and working together, he has an 85 in English and he's going to be on the Honour Roll this year for the first time in his life so it's been very empowering for him. (Connor's Mother, Interview #1)

Throughout the program, Connor's work was scribed for him to reduce frustration and to allow for greater details in his responses. Connor finds writing laborious and his printing can be difficult to read due to its untidiness and uneven spacing. Connor also finds typing to be difficult as he has difficulty recalling the positioning of the letters on keyboards.

He enjoyed the initial reading assessment session where he read text out loud. Connor, who is a self-proclaimed "confident reader", commented that he "loved this test because [he's] a great reader" (Connor, Interview #1). Connor displayed a high degree of confidence in his ability to read. He scored above average in fluency and decoding as measured on the GORT (Wiederholt & Bryant, 2001). Connor also demonstrated grade-level listening comprehension abilities, as displayed on the SAT (Stanford Achievement Test, 1995). While Connor presented himself as a fluent reader, his reading

comprehension abilities were lower than his decoding abilities and represent the reason why his mother enrolled him in this program. Connor is aware that he is a fluent reader who experiences difficulties understanding text. He described himself as "a distracted reader." Connor's mother elaborated that Connor appears to understand more of the text when she reads it to him or when he listens to recordings of his assigned readings than when he decodes independently. Connor's mother believed that the Kurzweil 3000 program would assist Connor in gaining higher comprehension levels and both mother and son appeared highly motivated to participate in this program.

> He typically loses his spot. Unlike in his earlier years, we no longer sit and read together much anymore. He would lose his spot. We would be reading, it would take a very long time to read a page. He would stop, he would ask questions. He was distracted. And now, it's the same thing. It's hard for him to concentrate on reading, keep his spot. It laborious for him … He's not an avid reader. He reads slowly. He has trouble comprehending what he reads at times. (Connor's Mother, Interview #1)

Connor explained that his 'tics' distract him while reading and that it is difficult to recall text information when reading independently (Connor, Exit Interview). Connor also displayed the signs of an "easily distracted reader" while completing the think aloud. He often began to discuss unrelated topics and would have to be prompted to refocus on the assigned text.

> During the think aloud, Connor displayed that he is easily distracted, as he stated in the interview, as he often interrupted his reading to discuss certain issues with me, losing his place in his reading. While some of these points would connect

with the reading, often the topics he brought up did not relate to the text topic. (Researcher, Field Notes)

Brianna

Brianna is a Grade 8 student in a south-western Ontario public school. She is 13 years old and presents herself as a friendly and polite teenager. Brianna was quite quiet in comparison to the other participants during the individual interviews and group sessions. This quietness seemed to be part of her personality as Brianna appeared to be comfortable with the other students in the group. While the other participants previously had participated in individual and/or group academic tutoring programs, this experience was new to Brianna.

Brianna and her mother stated that she enjoys school, and that she has enjoyed largely positive experiences in it. While Brianna attempts to keep up with her peers, Brianna's reading difficulties impact her academic progress.

> She [Brianna] struggles the most with English and math when they're doing problem solving because she has such a hard time reading it that she doesn't do as well in that. (Brianna's Mother, Interview #1)

Brianna is in a regular classroom and her curriculum is accommodated through an IEP. While Brianna has identified learning difficulties in reading, Brianna's mother reported that her primary accommodations involve procedures of assessment and evaluation of learning.

> [Brianna will have a] teacher come in to help her and when they have a test, she won't do as many questions on the test or they'll give her more time or they'll pull her to the resource room to do it. (Brianna's Mother, Interview #1)

Brianna also goes to the Learning Resource Teacher (LRT) when she requires additional assistance. However, Brianna qualified that she does not go to the LRT for assistance very often (Brianna, Interview #1).

Brianna does not enjoy reading. When asked about her reading habits and her nature as a reader, Brianna's mother replied that,

> She hates reading. She doesn't like to read and when she does have homework, she brings it home and I read it to her, that's how it is. Even a novel, if she has to read it, I read it or she'll read a page, I'll read a page, like that. (Brianna's Mother, Interview #1)

When asked to describe herself as a reader, Brianna stated that she was "not the best" and that she "just [doesn't] feel that comfortable" when reading (Brianna, Interview #1).

Brianna is decoding at a level below her grade and age level norms. She also has lower than average reading comprehension scores. Brianna's knowledge of strategies while reading also seemed quite low. When asked about how she processes text for meaning, she commented that she attempted to use mental imagery, "I picture what's going in my head from the book" (Brianna, Interview #1).

Brianna's listening comprehension abilities were higher than her reading comprehension abilities, explaining for her preference to listen to texts rather than reading text silently, "I think I just prefer when people read to me. I understand it more" (Brianna, Exit interview).

The combination of these factors made Brianna an ideal participant for this program. Specifically, she displayed greater listening comprehension than reading comprehension skills and had difficulty decoding and recalling text information. She had

not used assistive technology before this study and seemed excited about the prospect of using software that would assist in the decoding process, "I think I would be… good. I think it [Kurzweil 3000] would help me" (Brianna, Interview #1).

Devin

Devin presents himself as a very energetic and polite teenager. He is a 12-year-old Grade 7 south-western Ontario student. Devin's parents described him as "very creative" and as someone who "loves to draw" (Devin's Parents, Interview #1). During the initial interview, Devin described his enjoyment of attending school and his determination of achieving "good grades" in all of his school subjects (Devin, Interview #1). Devin has participated in numerous tutoring programs that have assisted him in gaining skills in the areas of decoding and reading comprehension strategy application. Devin's parents stated that Devin has struggled with reading since he began learning to read but only began getting additional assistance in Grade 5. Devin's parents report that the extra programming has greatly improved Devin's self-confidence as a reader and he has begun to read independently in his spare time at home "he'll go upstairs in his room now and read by himself" (Devin's Mother, Interview #1).

While Devin's parents have noticed an improvement in his reading ability and interests, Devin views himself as a reader who is, "not very good. It's kind of hard and I'm kind of slow at reading" (Devin, Interview #1). He prefers reading independently to reading out loud to others – a process which makes Devin feel apprehensive. Devin stated that his preference would be to listen to a reading rather than decode a text independently (Devin, Interview #1).

When reflecting on the skills that good readers use, Devin recognized that at times, he reads the words without taking the time to understand what they mean. Devin stated that in order to become more efficient at comprehending text, he would need to, "instead of reading the words, actually understand what it [the text] is about" (Devin, Interview #1).

According to Devin's performance on the GORT, he decodes at a level slightly below that expected for a student in his grade and age. His reading comprehension scores are slightly below grade level as well. Devin appears to be a strategic reader, using multiple strategies to read when he completed a think-aloud reading during his initial interview. Devin's use of strategies highlights his ability to incorporate taught reading strategies into his reading practice. Devin used his knowledge of reading comprehension strategies to assist him when he encountered difficulties in understanding the text.

> Devin: The scooper pushes the manure into a big 600-gallon (2,268 liters) concrete (*Devin struggles with word "concrete").* Sound it out... /con/ /cr/ /e/ /t/ ... Methane gas ... Oh, we talked about that in science class *(Devin makes a connection of prior knowledge of this topic)* in the atmosphere ... (Devin, Think Aloud, Interview #1)

Devin's preferred reading materials are non-fiction texts based on science and history. His interest in science was a motivating factor in joining the program. Devin also expressed his interest in learning how to use the comprehension strategies with the text-reader software while learning about science.

Devin had no experience or knowledge of assistive technology before this research program began. He expressed interest in learning about the types of technology

available to students who have reading difficulties, specifically speech-to-text software and text-reader programs, such as Kurzweil 3000. His main interest in the Kurzweil software was its ability to alleviate his difficulty with decoding and pronouncing words as well as understanding unfamiliar words, "I would like that better because then I could hear what the words are actually pronounced" (Devin, Interview #1).

Ally

Ally is a 13-year-old south-western Ontario Grade 7 student. Ally presents herself as a quiet and polite teenager. She participated in most discussions with ease and interacted nicely with the other participants. Ally stated that she enjoys reading, even though she has decoding and comprehension difficulties that are part of her learning disability. Ally's mother described how Ally often reads independently even though she encounters difficulties with decoding and comprehending text concepts:

> She loves to read, she reads all the time but she doesn't read every word. She makes up words as she goes or she looks at the length of the word, what it starts with and what it ends with and sort of fills in the blanks. That's probably half of her problem; that she doesn't understand what she's reading and she reads very fast. (Ally's Mother, Parent Interview)

Ally's learning disability has impacted her ability to decode fluently and comprehend what she is reading. Ally is decoding at a level below her grade and age norms. Ally's reading comprehension level is lower than her independent reading level. Ally is a reader who often decodes words without comprehending the meaning of text. Although Ally often mispronounced words, added in additional words, and had many miscues while completing a read aloud, she rarely noticed her mistakes, even when they

did not fit in with the context of what she was reading. Ally also presented limited knowledge of effective processing strategies while reading. She only identified "sounding out words" (Ally, Interview #1) as a strategy that she used in reading a grade-level text out loud.

Ally displayed difficulty in explaining her thoughts at times. Ally also had difficulties with writing (both handwriting and typing). Ally often reversed letters (order reversals: 'er' for 're', letter reversals: 'b' for 'd'). Her written work was difficult to read. Ally could decode her own writing, although at times she would stumble and then correct her errors while she read out loud. Ally also found typing to be a strenuous task due to the order of the letters on a keyboard, which she has trouble recalling when attempting to type. Throughout the program, Ally's work was scribed for her to reduce frustration levels and to allow for more detailed responses. Ally had participated in many other tutoring programs and had received additional instructional sessions as part of an after school program which emphasized reading comprehension, keyboarding, and non-fiction writing.

Ally appeared to be motivated to be a part of the program, as was her mother. During my initial meeting with Ally's mother, she displayed great interest in the Kurzweil software. Ally's mother stated that she thought "this [the program] would be perfect for Ally" (Ally's mother, Initial meeting). Ally also stated that she believed the program would be beneficial for her reading comprehension. Ally had experienced the Kurzweil software before in her public school; however, it would be the first time she would have an opportunity to use the program. When asked about how she would feel about using a text-reader, Ally said "I think it would help me." After the initial session

when Kurzweil was introduced to the students, Ally brought her mother in to the program early to show her how the program worked and what Ally could do with it. Ally's mother later discussed with me how this program could really assist her daughter in her education and was recommending the implementation of this assistive technology at the upcoming Individualized Program Review Committee meeting at her daughter's school.

Synthesis of Themes

After examining and analyzing the transcribed interviews and focus group, session data, including instructional progress, comprehension tests, and participants' recorded comments and discussions, as well as the researcher's field notes, several themes emerged. These included (a) technology as a hook, (b) proficiency of participants' strategy use, (c) integration of technology and question-answer strategy, (d) changing role of the instructor, (e) social interactions among participants, and (f) technology as a platform for differentiated instruction. These themes emerged as the researcher read and re-read through the data and found common links between data, and generated overlaying titles for each theme as it became prominent within the data (Creswell, 2007).

Technology as an Instructional Hook

As the interview transcriptions and field notes were reviewed, one of the main themes that emerged was the role of technology as a "buy-in" for the parents of the participants and as instructional "hook" for participants. The opportunity to work with the Kurzweil program appeared to be a highly valued feature of the reading program provided here, especially when gaining parent and participant consent. While very few of the parents were aware of the Kurzweil 3000 prior to the program, they all displayed a genuine interest in its potential impact to promote student learning. Specifically, parents

responded favourably, or "bought in" to the potential benefits that the text-reader software offered with respect to their children's reading, and the opportunity that the study provided to their children to receive training on text-reader software while receiving beneficial reading comprehension strategy instruction. Another part of the "buy-in" for parents was the potential for the AT to be integrated into the participants' educational programs at school.

> [Connor's mother] was very interested in having Connor participate in the program to see if hearing the readings would improve his reading comprehension. She has found that Connor often comprehended better when he listened than when he read to himself. She has often had to read texts to Connor at home and sometimes taped his readings or study notes for him to listen and review. She stated that he has poor attention and that this might be a reason for his lack of comprehension as he is distracted often and easily. She thought that having a program like the Kurzweil would hold his attention more and the visual and audio output of the text would be beneficial because of his attention problems. (Researcher, Field Notes)

Two out of four parents were unaware of any assistive technology for reading, including the Kurzweil 3000 software. Two parents had experience with their children using assistive technology as an accommodation. Two of the parents participated in an educational group for parents with children with Learning Disabilities and were aware of the Kurzweil 3000 program as well as other assistive technology programs. All of the parents were expecting that participation in the program would be beneficial for their children in a variety of ways, including promoting a positive attitude about reading,

increasing reading comprehension, and decreasing stress associated with decoding and the reading process in general.

As part of the introduction process, the Kurzweil 3000 software had to be explained to all of the parents, even with those parents who were familiar with the software. This explanation provided the parents with a more extensive understanding of the Kurzweil software and its potential benefits for students with reading difficulties. Ally's mother had heard about the Kurzweil software, but had little knowledge of its specifics. Thus, we spent a fair amount of time discussing the mechanics of the software prior to the program with Ally's mother concluding,

> I'm hoping that with the Kurzweil program and her [Ally] learning how to use it, she'll be using it from now on in school … I know it's available and I know she's been exposed to it.... So I'm hoping, from this program, that she'll continue to use it in school because I think it will be beneficial to her. (Ally's mother, Parent Interview)

Both Devin and Brianna's parents had no prior knowledge of Kurzweil 3000 or any other assistive technology. During the intake interview, text-reader software, such as Kurzweil 3000, were described as well as their potential benefits for student learning. Brianna's mother indicated that she read aloud to her daughter while Brianna completed her homework, "She hates reading. She doesn't like reading and when she does have homework, she brings it home and I read it to her, that's how it is" (Brianna's mother, Parent Interview). Brianna's mother hoped that the software would provide her daughter an alternative to her reading aloud to her daughter and that it would promote Brianna to become an independent reader (Researcher, Field Notes). Devin's parents were interested

in the comprehension strategy instruction portion of the program and the additional instruction in reading from someone other than themselves. During the interview, they both expressed that Devin's tutoring programs have contributed positively to his improving reading ability.

Mother: He's [Devin] probably always struggled but we really noticed it in Grade 3.

Researcher: And what has been his experience with school and with reading since then?

Mother: Since then? Oh, it's been better.

Father: It's been a lot better. Coming here [Reading Support Program], I mean as a parent, reading with your child, it's…

Mother: It's frustrating.

Father: Yes, it's frustrating. An adult helping a child with reading, coming to [a Reading Support Program] is a lot better.

Mother: You're more tired, coming after work.

Father: Yes, it's a student, it's not the same age but it's a student helping, it's a different person teaching your child to read, it has made a big difference.

Mother: And kids don't always listen to their parents. They're going to listen to someone else before they listen to us [parents].

Father: I think that's key. They get frustrated and …

Mother: … They shut down.

Father: Yes, they just give up. Coming here [Reading Support Program], it didn't solve all the problems but it's helped

Mother: I think it's done a lot actually

Father: Yes, it's helped a lot. It's kept Devin interested in reading. (Devin's Parents, Parent Interview)

These positive previous tutoring experiences may have played a large part in their decision to participate in the program. The science component of the program also played a large part in their decision to participate in the program, "Devin likes science right now" (Devin's Mother, Parent Interview). Although they had no prior experience with the Kurzweil program, they believed that their son would enjoy using it and that it would benefit his reading, "Devin will like this" (Devin's Parents, Parent Interview).

Similarly, the participants expressed interest in the Kurzweil 3000 software and appeared to be motivated to begin using the program. Only 2 out of the 4 participants had knowledge and/or experience using assistive technology. Similar to the parental data, the 2 participants who were members of the Learning Disabilities Association had received assistive technologies as educational accommodations in their school settings.

When asked about using the assistive technology, Connor commented that he was, "...pretty excited to get on it and see what it's like" (Connor, Interview #1). During his initial interview, Connor was "quite upbeat and seemed genuinely excited about starting the program" (Researcher, Field Notes). Connor had used assistive technology (speech-to-text software) at school and indicated that he enjoyed using it, "I was pretty excited to be using it because, like after I had gotten used to it, it was pretty fun." Similar to Connor, Ally had used another assistive technology (keyboard writing technology). Ally seemed to share in her mother's belief that the Kurzweil 3000 software would facilitate her reading experiences. During her first interview, Ally discussed her increased

comfort level with using Kurzweil 3000 and demonstrated an insight about how it could be used as an accommodation for her writing as well.

Researcher: How would you feel about using something like that [Kurzweil 3000]?

Ally: I think it would help me.

Researcher: Why do you think it would help?

Ally: Because I have trouble spelling words.

Researcher: So would be helpful to hear it back and see if you spelt it? What it sounds like?

Ally: Yes, and if it makes sense.

Researcher: Using the Kurzweil or something like that, do you think that it would it would be a good thing for you to use?

Ally: Yes.

Researcher: How do you think you feel about using that if you had the option in school?

Ally: I think it would be good. (Ally, Interview #1)

While both Brianna and Devin had no previous knowledge or experience with the Kurzweil 3000 program, they expressed interest in using it during the initial interview, asking questions about the software. "I think it would be good. I think it would help me. I think that if I was at home alone, without any help, without a teacher or anything, it would be helpful" (Brianna, Interview #1). Devin could not recall using any type of assistive technology and focused on its potential to assist him with decoding and pronouncing words; "I would like that better [reading with Kurzweil] because then I

could hear how the words are actually pronounced" (Devin, Interview #1). He also thought he would like to use the Kurzweil program at home "because it would be fun and I could understand the words more and I like to read more at home" (Devin, Interview #1).

As the program continued, the technology continued to serve as a motivational tool for the participants. Once the participants had gained proficiency using the software tools as part of the comprehension strategy application, they continued to explore the program and discuss its features. The novelty of using technology did not seem to decrease during the 6-week program, nor did the participants' enjoyment using it appear to dissipate. Throughout their exit interviews and the focus group sessions, participants commented that having the Kurzweil program, "...read to them, made reading easier and more fun" (Focus group, Interview).

> This was our third session using the Kurzweil and everyone has had the opportunity to become adjusted and comfortable with using the technology. None of the participants had any issues adjusting to the Kurzweil. At the beginning of session four, all of the participants stated that they enjoy using the Kurzweil 3000 software to help them with reading the assigned text. When we discussed using the text-reader at the beginning of the session, Brianna and Devin said that the computer voice had sounded weird and different at first but they became used to the voice quickly and now it no longer sounds strange. Connor thought it never sounded strange and said that he liked it right away and understood it. (Researcher, Field Notes)

Proficiency of Participants' Strategy Use

Initial sessions. Throughout the instructional sessions, participants appeared to develop the ability to apply the question-answer strategy independently. The question-answering strategy was introduced to the participants through explicit instruction and instructor modeling during the first session. As part of the modelling session, the instructor explained and demonstrated how to create higher-level thinking questions using the question stems, with the participants engaged in the discussion about the nature of these questions. Not unexpectedly, the participants required frequent prompting from the instructor during the first few sessions and produced many lower-level thinking questions about the text. The participants were reluctant to answer questions about the text and often the questions would be reworded and asked again to try and encourage participation. Also, the instructor often had to specifically ask direct questions to certain participants, such as, "Ally, we discussed the difference between a CSI investigator and a detective together. Could you please tell the group what you had said about the differences that you noticed between the two roles?" (Researcher, Field Notes). During these sessions, the instructor frequently modeled how to answer questions and would then try to encourage participants to provide their own answers to questions.

> I had to do a lot of prompting to get answers to the questions that I had created as part of my modeling. As we began using the question stems and began the discussion I first demonstrated how to answer a question. With the questions that followed, I found that the group was not very responsive when the questions were presented and that I had to include a lot of prompts with the questions and at times

include my own opinion on the question. The participants were responding to the prompting (although it was mostly Connor doing the talking among the group). (Researcher, Field Notes)

During the second and third sessions, participants' application of the question-answering strategy progressed. The participants began creating their own questions. There was also progress in the participants' ability to answer questions.

Ally: What is the meaning of CSI?

Researcher: Okay, so a memory question, one that you can recall from reading in the article.

Devin: I remember that. CSI means crime scene investigation. (Video, Session 3)

They began to answer each others' questions although the participants still required some prompting. However, the level of prompting was less than what was required during the first session. The participants were using a large majority of the memory question stems over the thinking question stems. However, the participants still required a substantial amount of guidance and support from the instructor.

I found that I did not have to do as much prompting for answers tonight as I did during the first session. The participants were discussing the questions with greater ease. I was still engaged in prompting answers from the group, especially with the girls, who participated less than the boys. (Field Notes, Session 2)

Group discussion often began with a participant presenting a memory-type question and the instructor prompting the other participants to respond.

Brianna: How would you use blood to solve a crime?

Researcher: (after waiting for a response from group) Does anybody have an

answer for that question? Think back to the reading. (Pause – Connor whispers to himself) Connor, what do you think?

Connor: Um, I guess if you analyze it, you could tell whose blood it was.

Researcher: (After waiting to see if participants respond to Connor's answer) Are there any other ways to use blood to solve a crime?

Ally: You could try to tell how the blood got there. (Session 2, Video)

Five out of the six questions generated by the participants during the second session were memory questions (Field notes, Session 2). They also struggled to create appropriate and meaningful questions using the question stems. More positively, however, when participants' questions were real aloud, they demonstrated an awareness of those that lacked meaning and clarity.

Ally (reading her question stem to me as we worked together): 'What do we already know about *we know about how they take apart the crime scene.*'

I read the question back to Ally after she read it to me and asked her if it was a question that she could answer. Ally then realized it was not "really a question" and so we worked together to find a stem that could create a question based on her idea. Ally changed this statement into a question – asking the others "how do they take apart a crime scene?" (Researcher, Field Notes)

In terms of participants developing metacognitive awareness surrounding the use of the question answer strategy, the participants did not develop this awareness during the first set of sessions. By the third session, the participants could recall the steps that were used in the strategy and had begun to independently apply some of these steps to the text reading. This skill acquisition began to become apparent by the third and fourth sessions;

however, the participants were still developing the metacognition that would assist participants in recognizing why these strategy steps were important in developing their reading and comprehension abilities. The participants' ability to use the skills developed before they became able to offer explanations as to why and how the strategy was useful. This lack of metacognitive awareness was demonstrated through discussions during the initial set of sessions. During discussions about the importance of asking questions, the participants provided very limited answers – providing very few short and simple responses such as, '...it will help you learn something' (Field Notes, Session 1).

Guided instruction. As the sessions progressed and the instructional style transitioned to guided instruction, the quality of the participants' discussions improved. The participants were producing thinking questions more readily, required less prompting to respond to each others' questions, and provided high-quality answers referencing information contained in the text and their relevant prior knowledge.

> Brianna: The question that I chose to share and discuss with the group is Devin's question 'What would happen if global warming never stopped?' I think that our earth would get really hot, like it said in our reading, and the ice caps will start to melt, which would mean that a lot of people would have to move. Anyone who lives close to the oceans or any water would be at risk for having their home flooded.
>
> Devin: Yes, and people would probably have to wear spacesuits because the air would be toxic and hot, so your body wouldn't be able to be out in the air. There also would be very little oxygen, so that's another reason for having to wear a spacesuit. The oxygen would have been replaced by carbon dioxide, and the

> higher levels of pollution killed all of the trees and plants, which helped to create oxygen for people. There would be no other living things except for humans, and they would be very sick if they had to live out in the air like the living things that would have gone extinct. (Session 6, Video)

Another example of the increased quality of discussion took place between Devin and Ally.

> Devin: What are some of the possible solutions to the problem of climate change?
>
> Ally: The climate is getting warmer, …so reducing some of our greenhouse gases.
>
> Researcher: And how would you reduce greenhouse gases?
>
> Connor: Reducing how much you drive … by walking more or changing the type of car you drive…not using air conditioners. (Video, Session 5)

The instructor's role began shifting from that instructional leader and strategy modeller to discussion facilitator, with participants being able to lead the discussions on their own. Participants began demonstrating facilitator and discussion skills with each other such as the critical rephrasing of discussion questions.

> Connor: I have a question to share. How would you use less energy? And I would have to say that I would play less video games and that would reduce the amount of energy I use.
>
> Researcher: Is there a way to connect that question to the article we read tonight by changing it a bit? We discussed how to reduce energy usage last session. How could we change this question to connect more with our reading tonight?
>
> Connor: [W]ell, we could talk about the types of energy we use … [and] what type is better for the environment. (Video, Session 5)

Independent strategy instruction. As participants began the final instructional set of sessions, they began to demonstrate that they were able to not only use the strategy independently but they also began to demonstrate higher level thinking skills and metacognitive awareness about the use of the strategy. Participants' questions tended to reflect higher-level thinking more so than lower-level thinking: "How does *Global warming* affect *people's lives?"* (Brianna, Question Stem, Session 6), "What would happen if *global warming never stopped?"* (Devin, Question Stem, Session 6), "What are some possible solutions for the problem of *Global warming*?" (Connor, Question Stem, Session 6), and "Explain why *inventors try to make things better."* (Ally, Question Stem, Session 7).

Furthermore, participants were able to answer and discuss each others' "thinking questions." For instance in session 8, Connor provided the following thinking question "What is the *most liked invention* and why?"(Field Notes, Session 8). This question resulted in a lengthy discussion with participants voicing strong opinions with appropriate justifications and exemplars, "...the television, because everyone watches it or listens to it and are entertained and to find out news", "...the telephone ... because it helps in emergencies and everyone can use it to call others", and "...the computer ... for kids, they use it for entertainment and to talk with each other and get information ... adults use it for work and to find information" (Video, Session 8).

During the final instructional sessions, the participants were also able to explain the steps that they would use to generate the questions without promoting from the instructor or reference to the "how to" chart. That is, the participants appeared to develop

metacognitive awareness about the parameters associated with using the question-answering strategy and were able to describe the importance of using each step:

> Researcher: Why are questions helpful to readers?
>
> Connor: Questions help us review what we know, like they get us thinking about what we read and what we already knew and figure out if what we already knew was right. They [questions] make us think about things more, like the environment, and make our own opinions about them. (Video, Session 8)

During the exit interviews, the issue of how questions are helpful also arose, highlighting metacognitive growth in participants' understanding of why questions are helpful to readers.

> Researcher: What about the question stems that we used? Do you think that's helpful in helping you to remember?
>
> Ally: Yes, I think it [questions] are helpful because I have to answer them and I think it helps me to remember what is in the text when I think about it after reading. (Ally, Exit Interview)

Integration of Technology and Question-Answer Strategy

In session one, participants were introduced to the question-answer strategy independent of the Kurzweil program. Participants had the opportunity to see how the strategy worked without the added responsibility of integrating it with the text reader software. In session two, use of the question-answering strategy was combined with the use of the text reader.

During the first three sessions, participants required substantial support with respect to activating prior knowledge before reading, creating notes about the texts during

reading, and generating and discussing all types of questions after reading. During these sessions, the participants were learning to use the Kurzweil.

> Researcher: So I've chosen my question stem and have created a question "Explain how the CSI documents the scene with notes." So what we have to do is think back to the reading and recall what we had heard about that topic. You may want to go back into the reading [on Kurzweil] and scroll through the text until you find the part about taking notes. Then you can listen to that portion again to help you create your answer to the question that I asked. (Video, Session 2)

The participants also required support in learning to scan through the text on the Kurzweil after completing the reading and using the text while they created questions using the question stems and to utilize knowledge gained from the text during conversations to support their answers.

> Connor (while he is trying to create a question): There is a word I want to use but I can't remember what it was exactly.
>
> Researcher: From the reading?
>
> Connor: Yes. I want to put it into my question because it's the best word but I forget what it is.
>
> Researcher: If you go back into the reading, you can find the word and have the Kurzweil read it to you again
>
> Connor: Oh right, okay. (Video, Session 2)

They all seem to use the Kurzweil proficiently and I have taken note of how much more comfortable they are all becoming with scrolling through the program and finding information, especially during answering the comprehension questions on

> the comprehension tests… I tried to encourage the participants to use the Kurzweil reading to help them create their question stem questions. I have modeled this technique for them in previous sessions… I have found that their questions tend to be quite general in regards to the subject… I encouraged them to use the reading, both before they went off to their computers and while I was walking around talking to them. I reminded them of how a person can use the reading to create a question. I circulated as they worked, looking at their questions and the stems and having discussions that encouraged the creation of more in-depth questions. (Researcher, Field Notes, Session 5)

While all participants were able to draw upon their previous experiences with computers and computer software to manage the Kurzweil software, "…you only need to tell us once because we understand how computers work and we understand right away how to use it once you've shown and told us!" (Video, Session 6). However, the participants required practice and instructor support when using the question-answering strategy and the Kurzweil software simultaneously, "…the participants needed the repetition and scaffolded learning opportunities and often asked questions regarding use of the strategy" (Field Notes, Session 5).

The participants' comprehension tests, which were completed at the end of each session, demonstrate their growth in applying the comprehension strategy and comprehending text (see Table 3). Overall, most participants' scores on the comprehension tests increased over the sessions with the average increasing as well. The fluctuation between the scores on the comprehension tests could be expected as each test

Table 3

Participants' Percentage Scores from Comprehension Tests

Participant	Average for Set of Sessions		
	Sessions 1-3	Sessions 4-6	Sessions 7-9
Connor	72	80	88
Ally	75	73	78
Brianna	70	56*	71
Devin	78	81	81

*Absent for Session 5

consisted of different questions and a variety of question types in order to resemble classroom worksheets. The tests were also scored out of differing amounts, (between 10 marks and 16 marks), which could have played a role in the participants' overall scores on the comprehension test as some questions provided opportunities to earn more marks on some session tests while other tests provided fewer opportunities to score additional marks. In addition, participants' overall interest in the topic may have also affected their performance on the comprehension tests. Comprehension tests were marked by the researcher using a general answer sheet and another elementary teacher. This allowed for inter-rater scoring of the tests, where discrepancies in scores could be resolved through discussion using the answer sheet as a guide. However, there were no discrepancies with respect to students' scores.

Towards the later instructional sessions, the participants' discussions were more elaborate than during the initial sessions, with participants displaying higher-level thinking, generating higher-level questions, and connecting their thinking to the text that they were reading with the Kurzweil software.

Devin: How does *inventing things* affect *the world?* (Question created while reading through text on Kurzweil)

Brianna: I would say that it has really impacted our world and makes it constantly change and has helped us. Inventions make our world change.

Connor: What if we replaced inventions with toy inventions, how does that affect the world?

Brianna: Well toys affect the world …well they keep you amused.

Researcher: What else do toys do for us?

Connor: They keep us from being bored out of our mind, they can entertain animals as well.

Ally: They keep us out of trouble!

Devin: They keep us active

Connor: Gives us energy through exercise. (Session 9, Video)

As the participants became more proficient with using the technology and the strategy, they also became more capable of manipulating the text within the software. The participants did not scan through the text and have the software reread potions of text to them to help in the creation of questions or to assist in answering questions at the beginning of the program. By the middle and end set of sessions, they began using the software to read the text after completing first initial readings, using the software to support their comprehension activities, such as scanning through text to find support for answers or to find text to assist in question generation.

I noticed that they were more capable of manipulating the readings in the Kurzweil than in the first set of sessions. This was encouraging as they were more aware of how to find information in the articles and this could assist them in creating questions from the question stems. I also noticed that they also seemed to retain more from the readings as I was able to hold conversations that were more in-depth about the topic than during the first set of sessions. (Researcher, Field Notes, Session 5)

The participants commented that they were processing the text more deeply while having the Kurzweil program read to them. They explained that while having the Kurzweil read the text to them, they were able to ask themselves more questions about

the text, make connections between previous knowledge and new knowledge found in the reading, and to have time to think/process what the reading was actually saying, as the participants had often said that they "read but sometimes [I] don't hear what I read" (Connor, Exit Interview).

> Researcher: Does it [Kurzweil] change the way you think while you're reading?
>
> Connor: Well maybe it made us think more about what was going on in the reading, focusing on the reading more and what was going on.
>
> Researcher: What did you focus on before, like if you weren't using the Kurzweil?
>
> Connor: Well, I was focusing on all the reading and listening to what was being read and all that. Seeing if I could answer questions from what I thought I heard while I read.
>
> Brianna: I think it's easier when it's [Kurzweil] reading to you because, I don't know, I just think about it more. (Focus Group, Video)
>
> Researcher: Did using the Kurzweil program change how you think about reading?
>
> Devin: It let me ask more questions to myself.
>
> Researcher: While you were reading?
>
> Devin: Yes, I had the chance to think more about it [the topic] and ask myself questions. (Devin, Exit Interview)

During the focus group session where participants discussed how text readers facilitated their processing of text, Ally commented that using the text-reader allowed her to generate questions using the question stems. Ally found that "it is easier to think

…while Kurzweil is reading to me" (Ally, Focus Group). When asked what she did to help her understand the information she responded that she did "the question stems … it [Kurzweil] gets you thinking about what you want to ask yourself" (Ally, Focus Group). Ally also agreed that using the Kurzweil software made reading easier as she did not have to "pronounce the words herself" – a process that she found difficult when decoding text (Ally, Exit Interview).

The participants were also able to elaborate how using reading with the Kurzweil could assist readers in using strategies, such as the ones we used during our reading program. The participants found that while having the Kurzweil to decode the text, it provided them with the cognitive energy to apply the comprehension strategy to, "think more about the text", both during reading and after reading (Focus Group).

> Researcher: When you sit down to read a text [using the Kurzweil], what can a person do to understand what the text says, so help them to learn from it?
>
> Connor: You can simplify it.
>
> Researcher: They can read it and then simplify it to themselves?
>
> Connor: Well I mean like they can read through and then probably like re-write it and see if they can probably simplify it to understand it better.
>
> Researcher: So do like a summary of the reading in simple terms. What else do you think they can do? Something before they read or after?
>
> Devin: They could ask the questions, like what do they already know or what do they want to know.
>
> Connor: K-W-L
>
> Researcher: And how would that help them learn the information?

Devin: Because they can find a purpose for why they're reading and if there is something, they can make connections. (Focus Group, Interview)

Overall, the integration of the strategy and the technology developed over time, with the instructor slowly relinquishing responsibility for and control over the use of the strategy to students. The participants were successful in applying the strategy independently and were able to articulate metacognitive information about why they were using it and the relation of this strategy with respect to text-reader software.

Researcher: Did using the Kurzweil program change how you think about reading?

Devin: It let me ask more questions to myself while I was reading. [I had the chance] to think more about it and ask [myself] some questions. … [While using the strategy] it's easy to do … [b]ecause you're still like reading basically. [The Kurzweil is the same as] reading to yourself. (Devin, Exit Interview)

Changing Role of Instructor

While the researcher's role as the instructor of the program and voice were dominant during the initial lessons, modelling the comprehension strategy and directing and influencing the majority of the discussion time, students' voices became more dominant as the program progressed.

The majority of the session's time today was 'teacher-focused' and I found it to be a learning experience for myself as an instructor. I wanted to have the participants involved more but a large part of this session was dedicated to the modelling of the strategy skills that I want the students to engage in and learn to use themselves. I am hoping that as the program progresses, I will see the

participants develop these skills and my instructional style will become more 'student-centred'. (Researcher, Field Notes)

The instructor's role became much more subdued as the program progressed, allowing for more participant interaction, discussion, and leadership responsibilities. While the instructor continued to participate and actively observe the lessons, the role changed from active instruction to discussion facilitator, with the participants being more independent in their application of the question-answer strategy

> My final goals for the program and this session were that the students be able to direct themselves in applying the questioning strategy on their own. Also, that the students would be able to effectively use the question stems to create questions and that students would gain a deeper understanding of the text through answering and discussing the questions formulated with their group members. I believe that each of these goals were met, through the scaffolded approach, the participants all became successful in applying the question-answer strategy with the Kurzweil, in effectively being able to use the question stems and develop a deeper understanding of the article as well as the topic. The group also displayed their ability to discuss the questions as a group with me [the instructor] acting only as a facilitator. (Researcher, Field Notes)

The technology also changed the role of the instructor as it appeared to encourage students to work independently. Having participants use individual computers seemed to promote independent work as these sessions were less interactive than working at the group workstation. Having the software assist students with decoding also appeared to

enable them to develop the ability to use the question-answer strategy independently as they no longer required as much assistance in understanding the text.

> ... the chance to learn to use the Kurzweil in a relaxed, non-grade based, small group environment gradually released responsibility to the students, and this allowed for more in-depth use and knowledge of the program and time to explore how to use and combine the use of the tools and features. (Researcher, Field notes)

Social Interactions among Participants

At the beginning of the program, the participants sat quietly, rarely making eye contact or speaking with one another. After completing an introduction activity, all the participants began to speak more with each other. Two of the participants recognized each other from participating in another tutoring program and quickly began speaking with each other. As the program progressed from session 1 to 3, the participants became slightly more open and talkative throughout the group discussions and sharing sessions became livelier. Connor's participation was especially pronounced in the second session and he quickly became the most outgoing and self-confident participant. Connor's engagement also encouraged others to participate. Participants provided more responses in the second session relative to the first, although they all required prompting from the instructor to express their opinions and thoughts, "Ally, what do you think? Do you agree that CSI would be a stressful job? ...Why do you agree?" (Video, Session 2).

During session 3, participants readily started conversations with each other, making eye contact, as well as discussing topics more readily without the instructor having to encourage discussion between partners. As the sessions continued to progress,

participants began leading discussions and the instructor role developed into one of a facilitator "… the participants became more engaged and begin holding their own discussion regarding their KWL charts, as I acted in the role of a facilitator, ensuring that the discussion stayed on topic" (Researcher, Field Notes). Having participants gain comfort with the group was critical to the success of the program as many of the activities required participants to work collaboratively.

During the second set of sessions, participants began greeting each other at the beginning of the program. This familiarity with each other reflected in their discussions during the sessions, as they appeared more at ease with each other. During the first set of sessions' videos display the participants' body language as being more guarded (i.e. lack of eye-contact and nervous fidgeting). During session 2, after reading the text and completing a think-aloud session where the creation of question stems was modelled, the researcher led a conversation based on the created questions,

> Researcher: So I've created the question *Explain how the CSI unit documents the scene using notes.* How could we use what we read to answer this question? [Participants are silent and make no effort to answer question] We discussed this earlier while we made our questions… [Silence from participants; Devin looks down at the table and plays with drinking cup, Brianna looks at the board and plays with her hair, Ally fidgets in chair and occasionally glancing around at others, Connor spins back and forth in chair without making eye contact with others].
>
> Researcher: Okay, so we have to think about what we read, trying to recall what we remember reading about notes. Another strategy we can use is to go back to

the text and read about where the author talks about using notes. If we do this, we can use the subtitles to help us find the section in the reading where using note-taking was discussed. So can anyone think of some ways that the CSI unit uses notes to document the crime scene? [Participants are silent. Brianna looks around at things placed on table but does not make eye contact with others, Ally plays with drink, Devin looks around at what other participants are doing, and Connor continues to fidget in the chair and occasionally giggle or smile]

Researcher: If we look back in the reading, we can see that they mentioned that they write down what they see, recording details. We discussed this earlier, where the CSI have to record only the factual parts, and not the opinion. Does anyone remember why that is? [Participants continue to remain quiet] (Video, Session 2)

While the first set of sessions reflected many silences during conversations and displays of behaviour that did not allow for quality conversations based on the topics, such as those demonstrated in session 2, the second set of sessions presented a more comfortable social environment. The researcher's field notes recorded these changes in the social climate with comments such as "Devin, Connor, Brianna, and Ally were very talkative during this session. Devin especially volunteered a lot more to the discussions during the entire session than in previous sessions" (Researcher, Field Notes, Session 6). During the second set of sessions' videos display participants with more relaxed body language, such as more eye-contact between participants, relaxed body postures, and less fidgeting.

Researcher: So get into pairs and go over the questions that each of you have created and then we'll come back as a group to discuss those questions that you

found of your partners' to be the most interesting. [Participants divide into pairs without prompting and begin work immediately]

Connor: What is a new example of global warming? Something that we haven't read about or talked about. [Direct eye contact with Ally. Explains his question so Ally understands the term new example].

Ally: Well, I heard about fish dying because of the water pollution here in Canada. And there's the fact that we can't always swim in the lakes around here. [Direct eye contact with Connor, no hesitation in answering, not fidgeting or looking around room, staying on task].

Connor: I've seen that too, where they have the water warnings up. Do you think that is because of global warming and stuff or because of people polluting? [Eye contact with Ally, not fidgeting]

Ally: I guess it could be both but still, the hotter the water gets, the worse the warnings will probably get. [Returns eye contact, sitting back in chair, not fidgeting]. (Video, Session 6)

While participants' visible behaviours changed, such as the increase in eye contact and the decrease in fidgeting during discussions, participants also became more willing to get involved in discussions and to share their questions and opinions.

Researcher: Would anyone like to share a question with the group first?

Connor: Oh, oh, oh! [Waving hand in air]

Researcher: Connor.

Connor: How would you reduce how much energy you use? [Everyone looking at Connor]

Ally: Not using so many appliances. Remembering to turn off the lights. [Engaged in conversation without waiting to be asked to participate, making eye contact with other participants]

Connor: And not playing video games as much [Eye contact with another participant when stating this comment, smiles and laughs about a common interest] (Video, Session 4)

The participants also began to join in on others' discussions without waiting for an invitation, displaying their familiarity with each other and feeling comfortable enough to voice another opinion to questions posed. These positive social behaviours continued to occur throughout the remaining sessions.

Technology as a Platform for Differentiated Instruction

The participants were an eclectic group, varying in their decoding and reading comprehension abilities. Two participants were diagnosed with learning disabilities; three had been formally identified by the school system as requiring accommodations including remedial programming as monitored through an IEP. Three of the participants were decoding below grade level and all scored below average on the standardized measures of reading comprehension used here. Three of the 4 participants demonstrated grade-level listening comprehension skills, with scores ranging from low average to average on the SAT subtest for listening comprehension. The fourth participant demonstrated below average listening comprehension performance scores. While the participants varied in abilities and skills, they shared a basic understanding of computers and computer software including the skills necessary to use the Kurzweil technology used in this study. The Kurzweil software compensated for the large variance of reading and

comprehension abilities between participants. The instructional techniques, along with the Kurzweil software, showcased a differentiated learning environment, allowing for learning differences among participants to be addressed. For at least 3 out of the 4 participants, it alleviated decoding difficulties and allowed them to focus on comprehension.

> Researcher: How do you feel about being asked to read a text using the text-reader software (Kurzweil 3000)?
>
> Ally: I like it.
>
> Researcher: What do you like about the Kurzweil?
>
> Ally: I like how it reads it to you and it can pronounce the words.
>
> Researcher: So that kind of makes it so that you don't have to do that.
>
> Ally: (nods)
>
> Researcher: How was using the text-reader software (Kurzweil 3000) helpful to you as a reader?
>
> Ally: It helped me understand words, like pronounce them. (Ally, Exit Interview)

Brianna and Devin expressed similar sentiments during their exit interviews:

> …would be happy with that [Kurzweil reading to her], I like it when other people read to me, I understand the readings more. …I think when the Kurzweil reads it [the text] to me I understand it more because … it's helpful to when you when you can see it [the text] when Kurzweil is reading it. … [I]t was helpful to me as a reader because I like when people read to me; I understand it more. … I think it's easier when the Kurzweil reads to you because it actually reads you the question, like the answer that you're looking for. …I would remember more because I was

paying more attention as I'm reading it [with Kurzweil]. (Brianna, Exit Interview)

...[I] liked reading with Kurzweil...because it's fun to use the Kurzweil. I like how you can change the voices and the speed. [I]f it's going too slow or too fast, you can change it [the WPM speed] or if you don't understand it you can slow it down. [Y]ou can also see the words while it's reading to you. ...[Kurzweil] might help you understand ... if you don't know a word and you don't know how to sound it out, it already has it sounded out for you. You can break it [a word] into syllables and get the definition too if you still don't understand it. (Devin, Exit Interview)

For Connor, using the Kurzweil technology allowed for a more focused learning environment that minimized distractions and increased time available to focus on comprehending the text.

Researcher: How do you feel about being asked to read a text using the text-reader software (Kurzweil 3000)?

Connor: Well, I'm perfectly fine with that.

Researcher: So do you feel the same about reading a text on your own and using the Kurzweil?

Connor: I'm not so sure about the text on my own. For that one, I should have said not too well.

Researcher: What's the difference between the two?

Connor: When I'm asked to read a text, that's when I get kind of distracted but

when I get asked to read a text using a text-reader I can probably put more focus on it because they could be talking to me.

Researcher: What do you think helps you to focus more on the text-reader than on reading yourself?

Connor: Well, if I'm actually hearing what its saying it seems more interesting. (Connor, Exit Interview).

Summary of Themes

The findings of this study provide a greater understanding of how these intermediate students' use assistive technology (a text-reader) while learning and applying a comprehension strategy (the question-answer strategy). The assistive technology software acted as a 'hook' for participants and a 'buy-in' for their parents. Throughout the program, the Kurzweil 3000 software continued to sustain participants' motivation to partake in all reading activities.

Participants' proficiency of using and understanding the question-answer strategy developed over the sessions, leading to participants being able to apply, use, and explain the question-answering comprehension strategy independently. Once the technology was integrated into the program, the participants were able to emulate the modeled strategy instruction and use the question-answering technique with the technology. As the participants gained proficiency in using the comprehension strategy and the software, the instructor's role changed drastically, going from modelling each step of the strategy to facilitating discussions among the participants.

Overall, the participants engaged in providing each other positive peer support and together, with the instructor, created a non-judgemental learning environment. The

social network that the participants formed developed into a comfortable and safe learning environment that encouraged peer interactions. The quality and quantity of discussions increased over the sessions, with higher-level discussions unfolding during the mid and later sessions. For example, when comparing participant dialogues across Session 2 and Session 6, participants were better able to draw upon information from previous readings and relevant prior knowledge in the later session. Participants' abilities to provide higher level responses to the answer questions developed by their peers also enhanced throughout the instructional sessions.

Finally, the integration of the technology provided a platform for differentiated instruction. The Kurzweil 3000 was utilized as an accommodation for a multitude of learning differences. While, for some participants, it alleviated decoding difficulties, for others it served as a motivator and a focus for attention. In other words, the technology served to decrease the amount of time the participant was distracted, "I thought I paid attention more" (Connor, Exit Interview).

Chapter Summary

The findings of this study can be used to develop a greater understanding of the potential for using text-reader software when providing struggling intermediate-grade readers with comprehension strategy instruction. The analyses of participants' experiences and work samples over a 6-week interval revealed findings that confirmed and/or extended previous research. For instance, the findings of this study confirmed that the use of explicit instructional practices while teaching comprehension strategies, such as the question-answering strategy, assisted participants in their ability to apply the strategy independently (Dole, 2000; Duffy, 2002). Participation in this program also

enhanced participants' metacognitive awareness about the value of the question-answering strategy and why it is used before, during, and after reading informational texts. The findings highlight that technology can act as an "instructional hook" for students and that their motivation can be sustained for extended intervals. The findings of this study also confirmed the changing nature of the instructor's role from a "leading" one to a "supporting" one with this shift reflecting students' ability to gradually apply comprehension strategies to grade-level text independently. The instructor's role also changed as the participants demonstrated higher quality and quantity discussion skills, such as creating higher-level questions and providing more detailed answered without prompting from the instructor or questioner. Participants' increased abilities to provide higher-level responses to their peers' questions also demonstrated their increased abilities to derive meaning from the text. Finally, the integration of the technology with the question-answering strategy provided a platform for differentiated instruction, with the Kurzweil 3000 being used as an accommodation for a multitude of learning differences.

CHAPTER FIVE: SUMMARY, DISCUSSIONS, AND IMPLICATIONS

In this chapter, the findings of this study are summarized and discussed in connection to relevant literature, acknowledging the research and theory implications. Also included is a discussion about the implications for practice. As part of this discussion, the benefits of having students with reading difficulties use assistive technologies as learning accommodations are highlighted. Finally, the chapter concludes with suggestions for future research.

Summary and Discussion

The purpose of this study was to examine the experiences of intermediate-grade struggling readers while learning to use a comprehension strategy in combination with using a text-reader. A secondary purpose was to examine the instructors' role and experiences as the integrated text-reader and reading comprehension program of instruction was delivered. The findings highlighted the development of the participants' proficiency in using the question-answer strategy, their experiences using assistive technology, and their concurrent experiences using both the strategy and the text-reader to enhance reading comprehension. Other themes included the changing role of the instructor, the motivational aspects of the technology, and the influence of the social components on the participants while in the research program.

Technology as an Instructional Hook

The text-reader, Kurzweil 3000, acted as a 'hook' for participants and as a 'buy-in' for parents as the software provides many beneficial qualities for students with reading difficulties and uses current technology. The computer, a form of technology that all of the participants were able to fluently use without much additional instruction, was

used to operate the text-reader software. As the data revealed, while participants voiced their positive opinions about how the software could provide them with assistance when teachers were unavailable, parents viewed this software as a tool that would support their children in becoming more independent and successful readers while enhancing their comprehension abilities. During the initial interviews, all participants expressed excitement to be part of the program and indicated that they believed that using the software would be beneficial to themselves as readers. In this way, the participants appeared to be intrinsically motivated to participate in the program. Hasselbring and Gion (2004) concluded that programs based on assistive technologies are most likely to be implemented successfully at the school level when students are intrinsically motivated and are mindful of the potential rewards associated with participating in the program at hand.

For the participants, learning to operate the text-reader and its features was an exciting opportunity and built upon their previously acquired computer skills. The program was designed to provide participants with time to explore the technology and its features in a relaxed, comfortable environment where questions and comments were encouraged. Consistent with Hasselbring and Bausch (2005) research, having an instructor who was trained to use and understood the technology helped establish a comfortable learning environment for both the participants and the instructors (i.e., instructors felt comfortable and qualified in providing answers and guiding participants).

From session 2 onward, participants were encouraged to discuss and reflect on the qualities of the text-reader, reflecting on their use of text-reader software as a tool and examining the benefits and drawbacks of the technology as a group. In his research,

Engstrom (2005) also confirmed that the participants benefited from reflecting on their use of the technology throughout their instructional program in addition to participating in an introductory session on the Kurzweil 3000.

The data gathered from the focus group and exit interviews revealed that the participants continued to be motivated in using the text-reader software throughout the entire program. This finding is consistent with the findings of MacArthur et al. (2001) who found that using a text-reader alleviates students' anxieties surrounding reading and decoding. When students are less anxious readers, MacArthur and colleagues found their motivation to become more engaged with the text and activities increased.

Proficiency of Participants' Strategy Use

During the first set of sessions, the majority of instruction was provided through explicit modelling to enhance participants' understanding of the question-answering strategy. Explicit teaching of how to use the question stems to create higher-level thinking questions allowed for the participants to become engaged in discussions about the topics presented. Using this instructional method, the participants were able to begin to apply the question-answer strategy and learn to use it independently. These findings confirm Dole (2000), and Van Keer's (2004) research which found that students with reading difficulties were able to acquire the skills to apply reading comprehension strategies effectively through the explicit modelling of an instructor.

Providing the participants with explicit teaching allowed them all to experience some form of learning gains, despite their varied decoding and comprehension abilities, consistent with the findings of other researchers (e.g., Dole, 2000; Pearson & Dole, 1987). As part of the modelling session, the instructor explained and demonstrated how

to activate prior knowledge, how to use new knowledge and make connections with prior knowledge when answering questions generated using question stems. This process facilitated numerous discussions prior to reading texts during the program (van de Broek & Kremer, 2000). To enhance the participants' abilities to recall, record, and organize their prior knowledge, they were provided with a K-W-L chart that allowed for them to organize their thoughts (MacArthur et al., 2001). The findings of the National Reading Panel (2000) confirmed that question generation and question answering are two strategies that assist in activating students' relevant world knowledge. By explicitly teaching participants how to apply these strategies to a variety of non-fiction text, the researcher provided a learning environment in which students with reading difficulties could experience success in learning to comprehend text materials that they are likely to continue to encounter in and outside of the classroom (Smith, 2000).

As the program sessions transitioned from ones focused on teacher modeling and explicit instruction to guided instruction, the researcher was able to scaffold the instruction to provide opportunities for participants to begin to apply the question-answer strategy independently. This finding was consistent with those reported by Duffy (2002), which demonstrated that explicit instruction allowed students to gradually acquire and apply a targeted strategy. The transition from modeled, explicit instruction to guided instruction also allowed for the researcher to begin focusing the participants' attention on why the strategy is being used rather than on how to use the strategy, encouraging metacognitive awareness. The participants' acquisition of strategy application before these discussions was believed to be an important component in facilitating their metacognitive learning as others have demonstrated that explicit instruction improves

students' metacognitive understanding of reading comprehension strategies (e.g., Block & Pressley, 2002; Fisher et al., 2002). The guided instructional sessions provided time for the participants to apply the strategy skills more independently and use discussion time to reflect on the importance of using this particular strategy. The participants' growth in metacognitive discussions was apparent only in the later sessions after they had skill acquisition and were able to use the strategy fluently.

As the participants gained skill in using the question stems (King, 1995), their quality of questions and answers improved as well. The participants went from generating lower-level memory questions to creating higher-level thinking questions. Also, participants were able to hold higher-level thinking discussions that included critical rephrasing of questions, critical thinking of responses, and connections to prior knowledge and text. Again these findings confirm those of other researchers (King, 1995; NRP, 2000; Ontario Ministry of Education, 2005; Sweet & Snow, 2003) that question generation and question answering improve students' comprehension and extend them to include the use of question-answering strategies while using text-reader software.

Integration of Technology and Question-answer Strategy

As participants began to use the text-readers and develop the skills to apply the question-answer strategy independently, their reading experiences were more reflective of that of "average students" according to research of Brown (2002). Specifically, these participants now demonstrated reading that was engaged, active, and an independent process. The use of a text-reader eliminated the participants' need to focus on decoding while reading, allowing for the participants to focus their cognitive energies on comprehending and developing metacognitive awareness (Brown). MacArthur et al.

(2001) confirmed that incorporating text-readers allows students to enjoy reading while gaining content and vocabulary knowledge, develop their comprehension strategies, and participate in grade-level curriculum content.

The quality of discussion during the sessions, both before and after reading, grew from low-level conversations to high-level discussions that included critical thinking and text connections. The participants were able to draw from the knowledge they gained from the texts and apply that information to critically thinking about questions, confirming Baddeley (2003) and Ormrond's (1999) research that text-readers can allow students to retain more information from text and apply their gained understanding to comprehension activities.

Baddeley (2003) and Ormrond (1999) also found that using text-readers simultaneously with learning reading comprehension strategies increases students with reading difficulties metacognitive awareness. In this study, participants also gained metacognitive awareness for the question-answering strategy as they used the text-reader software to circumvent decoding difficulties.

Participants were able to devote more of their cognitive processing towards comprehending the text as text-reader software accommodated decoding difficulties. Ally's statements that revealed how she was able to "think more about the text [while reading with the Kurzweil]" demonstrate how text-reader software allows for more cognitive energy to be directed at understanding the text rather than being used to decode the text. Text-readers allow for text to be read fluently, which Barr et al. (1995), Block and Pressley (2002), and Ivey (2002) found that, generally, the ability to read fluently assists in raising students' comprehension abilities. LaBerge and Samuels (1974) as well

as Sweet and Snow (2003) have found that fluency is a prerequisite for good comprehension. The text-reader software offered the participants in this study an alternative way to read fluently, providing participants with the opportunity to gain similar benefits as automatic decoders. The benefits include the freeing of students' cognitive capacities to allow for the comprehension process of text to take place, which extends upon the findings of LaBerge & Samuels (1974), Ormrond (1999), and Pressley (2000).

Changing Role of Instructor

While the role of the instructor was designed to change from direct modeling to guiding instruction, the rate of this transition was dependent upon the participants' learning experiences, especially with respect to strategy acquisition and application while using the text-reader software. As the participants gained in strategy proficiency, the instructor's role changed from modelling explicit instruction in strategy use to instructing in a guiding manner. When participants demonstrated fluent skill acquisition, the instructor's role converted into the role of a facilitator. This scaffolded teaching and learning approach reflects the constructivist orientation on which this program was based and demonstrates how, through explicit instruction, educators can teach students of varying abilities (Block et al., 2002; Brown, 2002; NRP, 2000; Palinscar & Brown, 1984; Paris et al., 1991; Woloshyn et al., 2001). Explicit instruction and scaffolding are also consistent with the principles of differentiated instruction as described by Tomlinson (1999; 2000). In this study, explicit instruction was a vehicle to provide participants with varying levels of background knowledge in applying comprehension strategies, with differentiated instruction in how to use the question-answer strategy. In this study,

explicit instruction was consistent with the principles of differentiated instruction in that all students, regardless of their prior knowledge of comprehension strategies before instruction, were provided instruction in the use of the question-answer strategy and text-reader technology (Thames et al., 2008).

Social Interactions among Participants

The program relied, in part, on the social abilities of participants as they were required to work together as a learning community and engage in discussions and group work. The social learning aspects of this program included using the question stems to generate questions cooperatively as well as participating in group discussions to create answers to the questions. Learning through interacting, problem solving, and discussing with peers is a style of instruction that has become more prevalent in the educational system (Barab & Duffy, 2000). According to social constructivist theory, student-centred learning and peer interaction have multiple benefits for learners (Barab, Hay, Barnett, & Keating, 2000). These benefits include developing students' problem-solving abilities, enhancing motivation and responsibility for learning, and developing and extending students' knowledge about effective strategies and content area through discussion (Barab & Duffy, 2000; Guthrie & Ozgungor, 2002; Ryan & Deci, 2000).

While the participants in this study learned to apply the question-answer strategy independently, group discussions always took place after the questions had been generated, even if the participants were responsible for answering their own questions first. King (1992, 1995) reported that generating verbal elaborations stimulated by the thought-provoking questions led to improved comprehension, a finding that was confirmed through this study, as the data documented participants' growth in applying

text information to critical thinking questions. Ryan and Deci (2000) suggest that when students work in cooperative groups, they can develop a sense of belonging and importance that can increase their intrinsic motivation and assume greater responsibility for learning. The data from this study indicates that participants became more comfortable within the group setting and this reflected positively in their abilities to converse with one another about text content and use the generated questions to guide group discussion.

Technology as a Platform for Differentiated Instruction

While the initial rationale for using the text-reader software as part of this instructional program was to circumvent participants' decoding difficulties, it became apparent that the software also provided the optimal environment for differentiated instruction. While the majority of the participants required some level of decoding assistance, each participant was unique in their decoding abilities and the level of required accommodation. For example, while Connor found the text-reader assisted him in focusing his attention on the text and on comprehending what was being read, Brianna used the text-reader for decoding unfamiliar words. In this manner, the text-reader serviced a variety of different learning levels and needs.

The inclusion of technology equalizes learning opportunities in various ways, depending upon students' needs and strengths. A text-reader is often used to alleviate decoding difficulties and allow for students to focus on their comprehension of the text (Balajthy, 2005; Blackhurst, 2004; Hasselbring & Bausch, 2005; Hecker et al., 2002; Marino et al., 2006). While teachers are responsible for the instruction of comprehension strategies, the technology software provides struggling readers with an ability to decode

at a level that is similar to that of other peers in their grade (Balajthy; Blackhurst). That is, text-reader software can transform previously inaccessible text to accessible text. Furthermore, the provision of explicit strategy instruction can ensure that students derive meaning from this text.

In short, participants in this study used the text-reader software while applying the question-answer strategy to grade-level readings that otherwise would have been beyond their independent reading levels (Donahue et al., 1999). With the text-reader serving as an accommodation for decoding difficulties, the participants were able to access grade-level readings and glean meaning from the texts independently. This finding confirms Disseldorp and Chambers' (2002) conclusions that intermediate students with reading difficulties achieve higher comprehension scores when provided with a text reader to read grade-level text.

Implications for Theory

The findings of this study were used to analyze and examine the experiences of intermediate-grade students with reading difficulties and their use of the question-answer comprehension strategy while using a text-reader. The analysis of the participants' experiences confirmed and extended previous research that documented the effectiveness of explicit teaching of comprehension strategies (Block et al., 2002; Brown, 2002; NRP, 2000; Palinscar & Brown, 1984; Paris et al., 1991; Pressley, 2000; Woloshyn et al., 2001) and the effectiveness of question generation and question answering to enhance students' reading comprehension of non-fiction text (King, 1995; NRP, 2000; Sweet & Snow, 2003). The findings of this study extend the research in the field as participants also used a text-reader as an accommodation, thus, documenting the experiences of the

participants' ability to use the technology while learning to use the question-answer strategy to enhance reading comprehension.

The underlying foundational constructivist theory assumed in this study was also confirmed and extended upon throughout the analysis of the findings. Consistent with Vygotsky's (1978) theory of the zone of proximal development and the role of scaffolding, the findings of the present study confirm that the use of scaffolded learning opportunities is beneficial to students with reading difficulties in learning to apply a comprehension strategy independently. The technology also served as a scaffold for students' learning. The text-reader software alleviates difficulties in decoding, enhancing students' processing of text for meaning (Balajthy, 2005; Blackhurst, 2004; Hasselbring & Bausch, 2005; Hecker et al., 2002; Marino et al., 2006).

In addition to scaffolding participants' learning experiences and using technology as a scaffold, the research program included explicit instruction and modelling of comprehension strategies. The present study found that the participants developed proficiency in their ability to use the question-answer strategy as well as metacognitive awareness through explicit teaching and modelling of the comprehension strategy (Block et al., 2002; Brown, 2002; NRP, 2000; Palinscar & Brown, 1984; Paris et al., 1991). That the participants were able to develop these skills while using text-readers provides educators with the use of another effective instructional technique, especially when working with students with reading difficulties.

The teaching environment is often analyzed from a dyadic perspective with a focus on the interactions between the instructor and the learner(s) (Graham & Wong, 1993). Within this study, the inclusion of the technology created a triad within the

teaching environment, adding a new dimension to the teaching and learning experiences for the instructor and the learner. This new dimension appeared to allow students to engage in learning to use a more interactive media option. Technology, such as text-reader software, provides students with reading difficulties with auditory accommodations so that they can more readily follow educators' instructions and presumably become independent learners. In this environment, educators must interact with technology; learn how to use it and learn how to integrate it as part of their instruction of the required curriculum. Educators must provide students with the tools to use text-readers appropriately and, thus, avoiding the temptation of relying fully on them to process text. In other words, students who use text readers must understand that they still play an active role in the reading process. Students need to be taught explicitly how to cognitively process or "think through" text while using text readers – that is, they need to learn how to derive meaning from text while using technology to support their efforts.

This study extends upon the research findings about the value of text-readers to accommodate for students' decoding difficulties and the abilities of intermediate-grade students to use text readers to improve their reading comprehension. Working with intermediate grade students (e.g., Grade 7 and 8) is especially important as limited research exists for these grade levels (Hecker et al., 2002).

Finally, the findings of this study support the theory of limited working memory and cognitive processing abilities, and the benefits of lessening decoding demands on some students to focus on enhancing their ability to comprehend (Baddeley, 2003; Ormrond, 1999). By alleviating students of their struggles to decode and the need to use all of their working memory to process the words, students can use their working

memory to process text meaning and apply comprehension strategies as taught by educators.

Implications for Practice

The implications associated with using assistive technology in the classroom are a very real and present concern for today's classroom teachers and students. As technology is integrated increasingly throughout the educational system, more programming options become available for students experiencing reading difficulties. The text-reader is a viable accommodation for those students with decoding difficulties who are beyond the "learning-to-read" stages in the school curriculum. Text-readers are providing educators with the opportunity to teach students with reading difficulties using the same or similar text that is used with their grade-level peers.

Using text readers as an accommodation allows educators to focus on teaching students comprehension skills, allowing them to develop an array of comprehension skills as well as the metacognitive abilities that will enhance their learning of curriculum materials. Text-reader software provides students with reading difficulties some of the tools and an 'educational platform' to become independent readers. While using text-readers does not eliminate the need for students to receive remedial reading and decoding instruction, it does allow for them to focus their attention on the comprehension of text materials and proceed with learning the same curriculum as their classmates.

While technology may alleviate students' decoding difficulties, providing the text-reader software does not provide students with all of the tools that they need to become a higher-level reader. In order to develop the ability to process text, students with

reading difficulties must be provided with thorough instruction that explicitly teaches higher-level thinking skills that can be applied to a variety of text.

Educators' instructional techniques when teaching comprehension strategies should include explicit teaching and modelling of strategies. The instructional sessions should provide all students with the opportunity to learn to use strategies effectively and to develop metacognitive awareness of why and how strategies are used. Students' learning should be scaffolded and should begin at the students' level of knowledge/instruction. By beginning comprehension instruction with explicit teaching sessions, educators can ensure that all students are aware of how the strategy can be applied to text readings.

Each classroom consists of a diverse group of learners, and there are many of those students who could potentially benefit from explicit instruction in comprehension instruction in conjunction with using text-reader software. However, this study's participants consisted of highly motivated volunteers- adolescents who were invested in learning how to use the technology, to take part in the group activities, and to learn the comprehension strategies. The dynamics of this group allowed for the development of a highly positive social and learning environment, which may not always be present in a regular classroom.

In addition to diverse groups of students, educators are also a diverse group with a variety of levels of professional knowledge on assistive technology, explicit instruction, and/or accommodating for reading difficulties. Educators require training in using assistive technologies before they begin to include assistive technologies in their lessons for students. The need for increased teacher education and in-service training programs

about assistive technologies parallel increased access to such technology, in part, resulting from the development of cost-effective software. In-service training sessions can provide educators with an understanding of the available assistive technologies for their students and can provide brief instructional periods on how to use specific programs. More in-depth teacher training programs should be provided to educators should they decide to include AT, such as text-reader software, as a part of students' accommodations. Training programs for educators should include information on how to introduce and instruct students in using AT, and how to integrate comprehension strategies like question-answering with the technology. The implications of these in-service and training sessions will increase educators' professional knowledge of the AT available for students with reading difficulties. These in-service and training sessions for educators may also lead to an increase in the use of AT by students with reading difficulties as more educators become aware of the benefits of AT for struggling readers and may begin to implement programs that include AT such as text-reader software.

Future Research

In this study, the experiences of intermediate-grade students using text-reader software to alleviate decoding difficulties while learning to apply comprehension strategies to grade-level text were recorded and analyzed. While the findings of this study add insights to the research in this field, there are still many unanswered questions. For instance, these findings can provide a foundation of quantitative studies exploring the effectiveness of several comprehension strategies or students' abilities to use text-readers in regular classroom environments versus specialized programs. Alternatively, research should be conducted using a variety of text materials including fiction with attention

focused on whether text topic affects students' ability to comprehend when using text-reader software. Other research areas that should be considered could extend the investigation of text-reader software within reading programs for students in the junior and primary divisions. Research is needed on the professional development that would instruct educators in becoming proficient instructors in assistive technology and its integration with evidence-based reading programs. That is, research on the development of training programs that focus on instructional techniques for combining literacy instruction with the use of assistive technology designed to develop students' knowledge of reading strategies while utilizing assistive technology, such as text-reader software.

Concluding Thoughts

As the world continues to become increasingly reliant on schools to educate all students, providing all students with the tools needed to assist them in becoming literate and knowledgeable members of society, educators are looking for tools that will help make all materials accessible to students and accommodate for a variety of learning challenges and difficulties. The increase in the variety of technological accommodations offered to students with reading difficulties has allowed these students access to the world of comprehension. While assistive technologies can create a more equalized learning environment for students with reading difficulties, programming success is reliant upon educators' abilities to instruct students in effective learning processes. Research continues to highlight the importance of integrating evidence-based teaching practices, such as explicit instruction, with the use of assistive technology. The findings of this study support the view that the integration of instruction using evidence-based

practices are important and vital components in the inclusion of text-reader software as part of students' educational programming.

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Appendix A

Outline for Lessons

Introductory Session	Students will come individually to discuss what the course sessions entail. Individual interviews with Participants and parents will take place. Discussion surrounding what their current interests and hobbies are – to assist in gathering readings that appeal to the majority of the group.	Comprehension test – to gain a measure of where participants' ability of comprehension of text is before taking the course. Observations (and Question period after test): Do students apply any comprehension techniques/strategies without prompting?
Closing session	Students will come individually to discuss how the course sessions went. Discussion surrounding their current feelings and thoughts towards reading, AT, and what they learned from the sessions will be discussed.	Comprehension test – to gain a measure of whether their skills have increased/ improved after taking the course.

Session	**Topic and Lesson Content**	**Goals**
Session 1	Introduction to Questioning Strategies: • Teacher Modelling (using sticky notes as a tool) → using before, during and after reading techniques. • Review/Discuss main points of strategy – how is it helpful? • Discussion on *Memory-type* and *thinking-type* questions – use questions from modelling as examples of question types. • Fill out I learned… portion of KWL. • Model how to answer comprehension questions asked at end of session.	Students can identify purpose of using questioning strategy. Students should be able to give a brief description of how the strategy is used (with prompting).
Session 2	*Before reading:* Introduction to text and its features.	Students are able to identify the strategy used

	Predictions on text. KWL chart on text topic. Review of question strategy introduced last day. Introduce question stems again as a tool to help develop questions. *During reading:* Model questioning strategy again while reading text using text-reader with modelled thinking *After reading:* Class - group questions based on type Discuss questions and fill out I learned… portion of KWL. Answer comprehension questions Students can explore features of the program and discuss in groups to find answers to questions.	with the Kurzweil and identify why it is used. Students are able to identify and sort types of questions into categories. Students have opportunity to become comfortable with technology. They can explore and select a voice and WPM speed.
Session 3	*Before reading:* Review of Questioning Strategy and complete "I know, I wonder…" portion of KWL chart. *During reading:* Teacher modelling with reading on the use of the Kurzweil Program – use sticky notes tool to write down any questions that you think of while reading the text Introduction to the Kurzweil sticky notes tool during modelled reading. *After reading:* Generate list of questions using question stems and sticky notes from reading. Discuss questions created. Fill out I learned… portion of KWL. Answer comprehension sheet Complete hands-on experiment	Assist students in understanding the computer program we will be using and Students will be able to apply learned knowledge gained from readings during a practical hands-on experiment.
Session 4	Introduction to new topic *Before reading:* Prior knowledge activation: KWL chart on topic of reading (I know, I wonder…) Guided application of the question strategy using Kurzweil text-reader. *During reading:* Students will each have their own computer and will read a paragraph at a time, using the sticky note tool to write down thoughts/questions. Teacher will guide them through this process.	Students will be able to identify how the questioning strategy is used with the Kurzweil 3000 program. Students will be able to use sticky note tool in the Kurzweil 3000 program.

	After reading: As a group, students (with teacher leading) will create questions and discuss. Comprehension question sheet to be answered at the end of session. Close activity – group debriefing on what they learned through using this strategy. Fill out I learned… portion of KWL.	
Session 5	*Before reading:* I know, I wonder… (two groups, students do together) Review steps of questioning strategy *During reading:* Guided application of applying the question strategy using the Kurzweil program. Students read text on their own and use sticky notes to write down questions after each section/paragraph (during reading). *After reading:* Students break into two groups, which come together after reading each chunk/paragraph to create questions. Discuss as class the questions/answers and fill out I learned… portion of KWL. Students complete comprehension question sheet.	Students will be able to participate in a guided application of the questioning strategy and can develop a question based on the assigned reading using the question stems. Students can identify what they have learned in a session from the reading.
Session 6	*Before reading:* Discuss purpose of reading, I know, I wonder… (two groups, students do together) Review steps of questioning strategy. *During reading:* Guided application of applying the question strategy using the Kurzweil program. Students read text on their own and use sticky notes to write down questions after each section/paragraph (during reading). *After reading:* Students break into partners, which come together after reading to create questions. Discuss as class the questions/answers and fill out I learned… portion of KWL. Students complete comprehension question sheet. Students complete hands-on experiment	Students will be able to "read" text and develop questions based on reading to facilitate understanding of text. Students will be able to collectively use their knowledge of the text to answer peers' questions.

	based on readings.	
Session 7	*Before reading:* Group is introduced to text (topic for next three sessions); establish a purpose for reading text. Students fill out "I know, I wonder…" portion of KWL chart on their own. *During reading:* Each student will read (using the Kurzweil text-reader) text, creating questions and collecting thoughts using sticky note tool. *After reading:* Individual– students will create questions using question stems. Students will try to answer their own questions and sort questions into memory-type and Think-type. Partner up – students will discuss questions they each created; try to formulate answers to questions Return to small group – teacher-selected leader will lead group in discussing higher level questions; finding answers. Complete comprehension question sheet and the "I learned" section of their KWL chart.	Students are able to direct themselves in collaboratively applying the questioning strategy and effectively use the question stems to create questions. Students are able to distinguish between memory and thinking questions. Students are able to create an above the line question without prompting from the teacher regarding what it is.
Session 8	*Before reading:* Group is introduced to text topic; Students fill out "I know, I wonder…" portion of KWL chart on their own. *During reading:* Each student will read (using the Kurzweil text-reader) text, creating questions and collecting thoughts using sticky note tool. *After reading:* Individual– students will create questions using question stems (this is also done during reading). Students will try to answer their own questions and sort questions into Memory-type and Think-type. Partner up – students will discuss questions they each created; try to formulate answers to questions. Students will pick their best question to share with group. Return to small group – teacher-selected	Students are able to direct themselves in applying the questioning strategy on their own. Students will be able to effectively use the question stems to create questions. Students will gain a deeper understanding of the text through answering and discussing the questions formulated with their group members.

	leader will lead group in discussing higher level questions; finding answers. Complete comprehension question sheet and the "I learned" section of their KWL chart.	
Session 9	*Before reading:* Group is introduced to text topic; Students fill out "I know, I wonder…" portion of KWL chart on their own. *During reading:* Each student will read (using the Kurzweil text-reader) text, creating questions and collecting thoughts using sticky note tool. *After reading:* Individual– students will create questions using question stems (this is also done during reading). Students will try to answer their own questions and sort questions into Memory-type and Think-type. Partner up – students will discuss questions they each created; try to formulate answers to questions. Students will pick their best memory-type and think-type question to share with group. Return to small group – teacher-selected leader will lead group in discussing higher level questions; finding answers. Complete comprehension question sheet part and the "I learned" section of their KWL chart. Students will work together to complete hands-on experiment that is related to what they have learned from the readings.	Students are able to direct themselves in applying the questioning strategy on their own. Students will be able to effectively use the question stems to create questions. Students will gain a deeper understanding of the text through answering and discussing the questions formulated with their group members.
Session 10	Debriefing and Closing Session – • Reflection on Learning from students (focus group) • "Celebration" of learning	Students will be able to state what they have taken from these sessions. Students are able to identify when they can use this strategy.

Appendix B

Example of a K-W-L Chart

K What do I know?	**W** What do I want to know?	**L** What did I learn?

Appendix C

Question Stems

Derived from Alison King's study on *Learning through Questioning* (1992).

What is a new example of ...?
How would you use ... to ...?
What would happen if ...?
What are the strengths and weaknesses of ...?
What do we already know about ...?
How does ... tie in with what we learned before?
Explain why ...
Explain how....
How does ... affect ...?
What is the meaning of ...?
Why is ...important?
What is the difference between ... and ...?
How are ... and ... similar?
What is the best ... and why?
What are some possible solutions for the problem of ...?
Compare ... and ...with regard to ...
How does ... effect ...?
What do you think causes ...?
Do you agree or disagree with this statement: ...? Support your answer.

Appendix D

Generic Chart Outline

Steps for Question – Answer Strategy

1. Review what you already know about the topic; 

2. Generate questions based on what you want to know about the topic; 

3.  Read the text in chunks and record any thoughts on sticky notes; 

4. Create questions on the topic; 

5. Answer the questions on the topic; 

6. Record what you have learned. 

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Appendix E

Example of a Comprehension Test

NAME:_____

CSI Part 1: Comprehension Questions

1. **Describe 3 people who are on the CSI scene and what each person does at the crime scene.**

2. **If you were to work at a crime scene investigation, what would your job be? Explain why this would be your job.**

3. **Define the following terms found in the text:**

   a. **Initial walk-through:**

   _____

   _____

   _____

   b. **District Attorney:**

   _____

   _____

   _____

4. **Why would having a job as a Crime Scene Investigator (CSI) be a stressful job?**

   _____

   _____

   _____

   _____

   _____

   _____

Clip art images are property of Microsoft (2003). Microsoft Office. Microsoft Corporation: Redmond, WA.

Appendix F

Initial Interview Question Prompts for Participants

1. What grade are you in?
2. What are your interests/hobbies?
3. What are your favourite subjects in school? Why?
4. What are your least favourite subjects in school? Why?
5. How do you feel about school?
6. How would you describe yourself as a student?
7. How would you describe yourself as a reader?
8. What do you think when someone asks you to read? How does reading make you feel?
9. Do you think reading is important? Why? (or why not?)
10. What are types of text do you enjoy reading (i.e. books, magazines, newspapers, comics, emails and text messages)?
11. How would describe the types of text that you read at school?
12. When you can't say a word in your book, what do you do?
13. When you can't understand a word in your book, what do you do?
14. When you are reading, what do you think about?
15. When you read a text and have to remember information from it, describe some strategies that you use to remember the information.
16. What does a person have to learn and do to be a good reader?
17. What do you think are some things that you need to learn to be a better reader than you are right now?

18. Are there any tools that you use at school that help you with your work (i.e. word walls, vocabulary charts, assistive technology)?
19. Have you ever used assistive technology (i.e. text-reader software, recorded books/books on tape, Dragon Naturally Speaking, Co-Writer) when reading?
    When and where (what subject(s), grade(s)?
    How did you feel about using it? (If no, have you ever heard/seen of assistive technology? What have you heard about it?)
20. What do you think and feel about using assistive technology to help you read?
21. What do you think about others (younger students, Gr. 1, 2; every teacher having Kurzweil in their classroom, Kurzweil being available in the Resource room) using Kurzweil? Who do you think should use the Kurzweil?
22. If you were provided with everything you needed to use the Kurzweil at home, would you use it there? Why/why not?

Appendix G

Exit Interview Question Prompts for Participants

1. How would you define yourself as a reader?
2. How do you feel about being asked to read a text on your own?
3. How do you feel about being asked to read a text using the text-reader software (Kurzweil 3000)?
4. How was using the text-reader software (Kurzweil 3000) helpful to you as a reader?
5. Were there aspects of using the Kurzweil that were not helpful or frustrating?
6. Would the Kurzweil text-reader be a useful tool for you to use at school if you had everything you needed to use it in your classroom? Why (why not)?
7. Would you use the Kurzweil text-reader at home to assist with reading if you had everything you needed to use it at home? Why (or why not)?
8. How would you feel about using assistive technology in your classroom? (prompts: How would you feel using Kurzweil in English, in the classroom if there was a computer for you?)
9. When you read a text and have to remember information from it, describe some strategies that you use to remember the information.
10. What do you think about while you are reading a text?
11. Did using the Kurzweil program change how you think about reading (did it give you relief, from sounding out words)? If yes, how do you think Kurzweil helps you with that?

12. In your opinion, is it easier to apply the question-answer strategies to the readings while using the text-reader to read the text than it would be if you had to read the text and apply the strategy? Why do you think this is?
13. If you were to tell another Grade 7/8 student what you did in the Science and Reading program, what would you tell them? Give me one good/cool thing about this program.
14. Could you see yourself using Kurzweil in other subjects (i.e. English, math history, geography, math, phys ed.)?

Appendix H

Interview Question Prompts for Parents/Guardians

1. Describe your son/daughter's experiences with reading.
2. How would you describe your son/daughter as a reader?
3. What are your son/daughter's reading habits? What do you see them reading at home?
4. How would you describe your son/daughter's school experiences?
5. What are your son/daughter most successful experiences with school?
6. What subjects does your son/daughter require the most support in?
7. Do they have formal IEP accommodations or modifications that assist them with reading at school?
    a. If yes, what are they and how have they assisted in your child's reading ability at school?
    b. If no, what is done at school to accommodate for your child's reading difficulties?
8. Has your son/daughter ever used assistive technology, such as a text-reader, to help them overcome reading difficulties?
    a. If yes, what was the assistive technology your son/daughter used? How did they respond to using the assistive technology?
    b. If no, have you ever seen/heard of any assistive technology that you think could benefit your son/daughter?
9. Has your son/daughter ever been tutored or involved in programs that assist with reading outside of school before?

a. If yes, please describe.

Appendix I

Focus Group Question Prompts

1. How can the Kurzweil 3000 text-reader assist a student in reading?
2. What are the positive/negative aspects about using the Kurzweil text-reader?
3. Are there any aspects of the Kurzweil text-reader that may be difficult to understand or to use? (Are there any drawbacks/downfalls to students who use this technology?)
4. In your opinion, is the Kurzweil a good tool for a student to use when reading higher level text (text that is usually harder to read)? Why do you think this?
5. What can readers do to help them learn the information from the text?
6. Would you use text-reader software at home or at school? Why or why not?
7. Does using the Kurzweil change your thoughts about reading? How did your opinions change?
8. Does using the Kurzweil change your thoughts about reading before having to read?
9. Does using the Kurzweil change your thoughts about reading while you are reading?

Appendix J

Brock Ethics Clearance

Brock University
Office of Research Services
Research Ethics Office
St. Catharines, Ontario, Canada L2S 3A1
T: 905-688-5550, Ext. 3035/4876 F: 905-688-0748
www.brocku.ca

DATE: February 15, 2008

FROM: Michelle McGinn, Chair
Research Ethics Board (REB)

Michelle K. McG

TO: Vera Woloshyn, Faculty of Education
Teiha McGee

FILE: 07-184 WOLOSHYN

TITLE: The impact of a text-reader support program on intermediate students' reading comprehension

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The Brock University Research Ethics Board has reviewed the above research proposal.

DECISION: Accepted as Clarified

This project has received ethics clearance for the period of February 15, 2008 to April 30, 2008 subject to full REB ratification at the Research Ethics Board's next scheduled meeting. The clearance period may be extended upon request. ***The study may now proceed.***

Please note that the Research Ethics Board (REB) requires that you adhere to the protocol as last reviewed and cleared by the REB. During the course of research no deviations from, or changes to, the protocol, recruitment, or consent form may be initiated without prior written clearance from the REB. The Board must provide clearance for any modifications before they can be implemented. If you wish to modify your research project, please refer to http://www.brocku.ca/researchservices/forms to complete the appropriate form Revision or Modification to an Ongoing Application.

Adverse or unexpected events must be reported to the REB as soon as possible with an indication of how these events affect, in the view of the Principal Investigator, the safety of the participants and the continuation of the protocol.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research protocols.

The Tri-Council Policy Statement requires that ongoing research be monitored. A Final Report is required for all projects upon completion of the project. Researchers with projects lasting more than one year are required to submit a Continuing Review Report annually. The Office of Research Services will contact you when this form *Continuing Review/Final Report* is required.

Please quote your REB file number on all future correspondence.

MM/kw